The Dock and Harbour Authority

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Editorial Comments

The Port of Buenos Aires.

The City and Port of Buenos Aires, the Federal Capital of the Argentine Republic, is situated on the right bank of the estuary of the La Plata. The river at this point, has a width of about 45 kilometres (28 miles), but it is comparatively shallow and the available depth in the navigable channel is the subject of periodical notice in the press. As a description of the berthage accommodation and cargo handling facilities of the port appeared in this Journal in November, 1920, and further details were given in July, 1933, a repetition of this information would be superfluous.

The present operational methods of the port have been the subject of much criticism during recent years, and it has long been recognised that a completely satisfactory solution can only be effected by drastic and far-reaching alterations to the lay-outs of both the port and the city.

It will be remembered that in April, 1939, Chief Engineer Ernesto Baldassari, Director General of Navigation and Ports, in an interesting lecture delivered under the auspices of the Argentine Society of Engineers, gave details of a project for the creation of a port area for coastal traffic and a riverside station. Senor Baldassari's informative address, which was published in the March and April, 1940, issues of this Journal, dealt, however, solely with the problems involved in providing better accommodation for the coastal trade and coastal passenger traffic and no over-all plan for the entire port was mooted.

A detailed study of this problem was undertaken in 1939 by Professor Alfredo Melli, who collaborated with a group of distinguished civic planners to work out a scheme for improving the port facilities in combination with the development of the city. Professor Melli's far-reaching, and perhaps controversial, proposals form the subject of the leading article in this issue and make a very interesting study in port planning. It should, however, be borne in mind that the proposed development plan only embodies a number of recommendations which have been put forward solely with a view to focussing attention on the present shortcomings of the port.

Mod l Experiments for Docks and Harbours.

The announcement that the Department of Scientific and Industrial Research is to set up an organisation with the problem of "Loose Boundary Hydraulics" will be welcomed as a means of giving valuable aid to British firms and Civil Engineers engaged in the planning, construction or development of dock and harbour projects, especially those abroad.

The problem of Loose Boundary Hydraulics, i.e., the movement of fluids in natural channels and streams, as distinct from the flow in pipes, has, for some years past, engaged the attention of the Institution of Civil Engineers, and recently they approached the Council of the Department of Scientific and Industrial Research and suggested that research on this subject, mainly by means of models, was becoming increasingly desirable. The Council, after examining the matter in some detail, found there was no existing organisation which could cope with the problem, and accordingly has proposed that one should be set up under their auspices.

It is obvious that this will take some time to establish and furnish data, so that immediate results cannot be expected, but the scheme will certainly have the good wishes of all who are engaged in experiments with tidal models, as they will be the first to admit that at prseent, they are only on the fringe of a solution of many problems connected with esturial hydraulics. It is possible that, in the not far distanct future, new discoveries may revolutionise the present methods of approach to these problems and produce results appreciably modifying generally accepted views on the subject.

Port Development and Trade Economics.

To what extent the facilities of a port affect the economic well-being of an industrial district has been carefully investigated by the Tees Conservancy Commissioners and the Borough Council of Middlesbrough. The result of their joint deliberations was the application by the Commissioners for Parliamentary powers to improve the river facilities and to take over the existing L.N.E.R. dock at Middlesbrough. To this end the Tees Conservancy Bill was recently presented before a Committee of the House of Commons and formally received approval, after the hearing of evidence in support of the Bill by Industrialists, Ship Brokers and Councillors of the district; and opposing evidence offered by the Railway Company.

On the one hand we have representatives of an industrial community and a competent harbour board stressing the urgency of adequate and up-to-date dock facilities, not only to cope with, what they claim to be, present needs, but also future requirements. They visualise that at the present time old *laissez faire* methods will not do; in fact they contend it is imperative that an easily

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accessible, spacious and well-equipped dock must be provided to attract modern shipping.

On the other hand the Railway Company owning the existing 100 years' old dock insist that a new competitive dock is unnecessary; that their dock is not used to full capacity at present, and even if trade increased, they could comfortably deal with all traffic, in spite of the fact that just prior to the war, owing to the falling off in traffic the number of travelling cranes for general cargo had been reduced from 49 to 30. The Divisional Manager, Mr. Jones, laid stress on the fact that the existing dock was coping with the present trade of the district and that he had no reason to hope for any expansion in the future.

This is surely a narrow way to plan for our necessities. Industry must expand, and amid all the uncertainties of the present time it behoves all authorities to handle their trusts boldly. It is not sufficient nowadays to be content with static values, there must be progress. As Naval architects have improved the mile-ton capacity of our ships, though at a considerable increase of capital cost, so must dock authorities follow suit and provide everything possible for quick turn-round and safe berthing.

Economists are agreed that to maintain our pre-war standard of living under the heavy burden of war debt, it will be necessary to increase our exports by 75%. This cannot be done without an increase of our imports of raw material. The logical conclusion is that there must be a substantial increase in deep sea traffic. Therefore our ports must be equipped with the latest appliances and provide easy manœuvring areas for access and swinging. They must also be adequately served by road and rail with ample transit sheds. Above all they should be economically sound from the points of view of the owning authority and the ship-brokers.

On several occasions recently, questions regarding port economics have been raised in the House of Commons, and one, in particular, asked the Minister of Transport whether he would give sanction for all the developments and extensions contemplated by some of the major ports. In reply, the Minister said he could not hold up development in one port to the advantage of another.

It is now no secret that the spate of war requirements found many of our ports ill-equipped in structures and equipment necessitating urgent priority work to meet programmes. As the matter of development now stands we must be prepared to cope with at least 50% increase of port traffic. It would therefore appear to be a wise precaution for our Dock and Harbour Authorities to co-ordinate overall planning to that end.

European Inland Transport.

An instructive address dealing with the transport problems confronting the nations of Europe was recently delivered in London by Professor E. R. Hondelink, Director-General of the European Central Inland Transport Organisation. Professor Hondelink covered in great detail the three main branches of transport, Railways, Roads and Inland Waterways, and a summary of his lecture appears elsewhere in this issue.

Recent reports from abroad state that transport facilities are steadily recovering from the havoc and devastation caused by the late war, and this is satisfactory as far as it goes, but the improvement reported to date is necessarily slow and there still is much leeway to make up before conditions become normal. At a press conference held in the middle of June, Dr. B. Sorma, Executive Chairman of the E.C.I.T.O., stated that the waterways of the German system could handle double the current traffic and the Elbe will soon reach pre-war capacity. Difficulties continue to be experienced on the Oder and the problem of the Danube is on a diplomatic level and remains to be settled at the Foreign Minister's Conference.

The European Central Inland Transport Organisation will normally come to an end in September, 1947, and the statement attributed to Dr. Sorma that it was hoped that by then, the Continental traffic system would approach pre-war standards appears to us to be rather too optimistic, especially when the present conditions on the Continent are taken into consideration.

The temporary Transport and Communications Commission which was recently set up by the Economic and Social Council of the United Nations, has recommended that E.C.I.T.O. should be brought immediately into relation with the Economic and Social Council, on a provisional basis, pending its eventual reconstitution as a permanent specialised agency, and that the Organisation be requested to consider the question of its permanent functions as a co-ordinating agency for the different forms of inland transport in Europe, and report on this question to the Council.

It is to be hoped that when the countries of Europe are finally freed from military control and trade has returned to normal, political considerations and selfish national interests will not jeopardise these plans for a controlling body which in the light of present day economics would appear to be essential for the future well-being of Europe.

A Lamentable Accident.

Cases of Workmen's compensation that go to the courts for settlement give rise to many interesting sidelights on the apportionment of responsibility as between employee and employer. Naturally as far as one's personal feelings are concerned, one has the greatest sympathy for a fellow man who, in the course of his employment suffers serious injury, but it is another thing when it is pleaded that in the ordinary sequence of operations of a job, and an accident ensues, that an employer is responsible for the continuity of the operations involved; in other words, that he must ensure that workmen conduct their operations in a settled way.

In the case of an unfortunate docker which recently came up at Liverpool Assize Court before Mr. Justice Stable, the claim of the plaintiff was dismissed. The claim arose for injuries sustained by a docker while attempting to insert a skid under a bundle of thin steel bars, lying on the ground, to facilitate the placing of a chain sling about the middle. As is the customary everyday procedure a crane picked up one end of the bundle to give the required space to pass the skid under it. Owing to the flexibility of the bundle the rope sling to which the crane hook was attached slipped and the bundle dropped on the end of the skid which was being inserted. The plaintiff was struck on the jaw by the skid and somersaulted backwards receiving severe injuries.

As the judge pointed out, this method had been employed in handling " thousands and thousands " of tons and the case must be decided as to whether the defendants failed in their duty to provide a proper system of work and whether the failure to provide such a system was the cause of the accident. He further made the following wise comment: " I think there is a risk in every act that one does from the cradle to the grave. From a stevedore's point of view this job was an elementary one and there was no risk attached to it, except that element of risk that is always evident when heavy weights are lifted from the ground and swung about. To find for the plaintiff in this case would be to lay down a false standard and to impose on the employers a duty, regardless of everything else attaching, to use the safest possible system for every operation, until ultimately one gets to an absurd position. . . ."

Reasonable people will agree with this comment of his Lordship. Workmen, particularly such as the plaintiff, a man of 20 years' experience of handling heavy weights, would resent being told how to do their jub. Each man has a pride in his own performance and seldom or never would he welcome criticism of his ability or judgment. In such an elementary operation as the subject of this action there is little doubt that the unfortunate man, prior to the accident, would have laughed to scorn anyone who had the temerity to point out possible dangers.

However the accident did happen and the motive of the injured man in bringing the action is plainly to ensure that in his future incapacity he will not further suffer from want. Such cases enlist sympathy and doubtless there are assured sources from which he will draw sustenance.

As the Judge foresaw in his summing up, there may be an appeal on a higher level, hingeing on the point that the system of handling was defective; that the bundles of bars should have been resting on cross skids, so that the slings could be passed through without prising up the ends of the bundles. In other words, the plaintiff pleads that there is only one proper way to do the job. This would amount to absurdity, for all over the world in all places where such materials are handled, the workers themselves adopt the expedient best suited to their needs and appliances.

Proposed Development Plan for the Port of Buenos Aires

By PROFESSOR ALFREDO MELLI
(Professor of Navigation and Ports in the National University).*

IN 1939 I was granted the opportunity of making a detailed study of the Port of Buenos Aires with the object of considering this vitally important element of the Republic's economy, not only from its limited technical aspect but also from the wider view of general city planning.

It was my task to collaborate with a group of distinguished architects and to work out with them an integrated plan for the Federal Capital, in accordance with the most modern and the most rational principles, developing the port facilities to the greatest possible extent while at the same time making ample allowance for traffic needs for a long period ahead, allowing for the development of the city itself without affecting either its functional or aesthetic needs.

In the first instance my survey was confined to an examination of the existing port works and installations, in order to decide which should be maintained and which should be demolished to comply with the above requirements. In general, this examination revealed an unsatisfactory state of affairs, especially from the point of view of city planning, because in many districts the port works have retarded reasonable development. Moreover, the future outlook is even more serious, due to the inevitable port extensions creating a veritable belt of embankments and quays surrounding a large part of the city, thereby completely preventing any possibility of its ultimate extension to the river bank.

Even before I looked into the purely technical problems of the port, my examination of the existing works led me to the conclusion that in order to achieve those ends which I considered indispensable to its complete transformation, the following works would have to be carried out:—

(a) Complete elimination of that section of the port lying within the natural limits of the city, namely: the North Basin, the Docks, the South Basin and the quays at Barracas and at Riachuelo, and to incorporate the large area thus set free, between the Plaza and the Boca, within the commercial quarter of the city.

(b) The works and installations thus eliminated to be replaced by others of a more modern and efficient type, sited in such a manner that they would not affect the development of the city in any way.

(c) These necessary extensions should be planned for a distant future, in view of the certain increase in traffic, with the object of ensuring that the port would operate at maximum efficiency without any prejudice to the city.

The time has now arrived to discuss these problems. There are immense possibilities of development in this much favoured country during the next few decades, which may reach unsuspected heights; if sound economy leads to the growth of maritime traffic harmoniously distributed amongst the various ports which serve distinct regions of the Republic, it is undeniable that the Port of Buenos Aires will play a leading part and it should therefore always be ready to deal with ever growing demands, both with respect to the volume of traffic and the characteristics of the many large and fast vessels which will return to the high seas for their peaceful task.

The annual cargo traffic reached a maximum figure of 12.5 million tons in 1937. I consider that a reasonable plan for future extensions should take into account a figure at least double this amount, without discounting the possibility of still greater increases and within the limits that I have laid down for a solution of the problem. In presenting this study, I would emphasise that it embodies a " proposed development plan " rather than an exact " project," but it does lay down a scheme of works to which detailed study must be devoted and which should be developed in stages, according to the needs which arise in the ordinary course of events.

Neither does this study offer the only solution to the problem, but it should tend to promote a full discussion of the matter and at the same time draw the attention of the authors to the urgent need for considering the problem on its own merits, that is to say as one of the most important public works in the Argentine Republic, both from the economic and technical points of view.

1.—Present Position of the Port of Buenos Aires

The Port of Buenos Aires consists of four main sections, each entirely distinct as regards its technical features and siting, in addition to its nature and to the type of traffic which has been developed therein. Starting from the east end of the city, from north to south, are the following port works:—

(a) The New Harbour, which extends from the Third of February Park to the Plaza Britanica, comprises five independent open basins, separated one from the other by parallel quays, lying in an east-west direction. Each basin is 140 metres wide and its length varies from 350 to 385 metres, giving a total of 5,900 metres of wharves, without counting the six ends, and providing a depth of water of 10 metres (33 feet). These works are protected against waves generated in the estuary by a jetty some 3,000 metres in length; a second jetty, 1,500 metres long, protects the North Entrance to the Port.

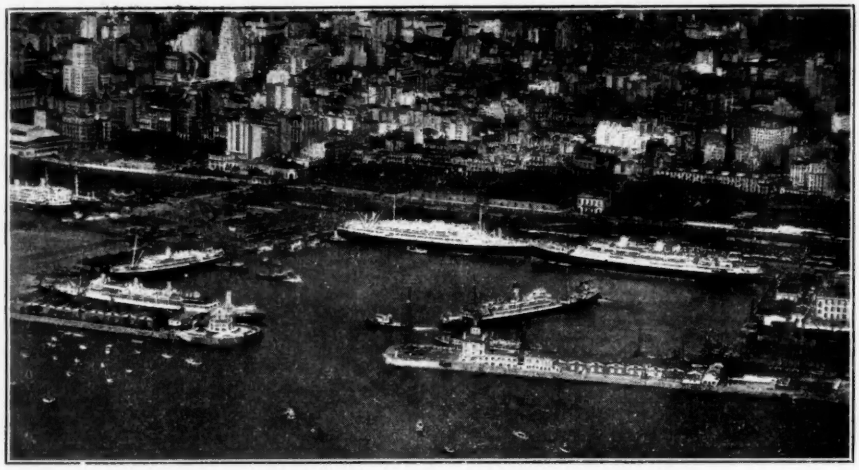
The New Harbour handles part of the ocean cargo traffic which, in 1936, the year of maximum movement so far recorded, amounted to the loading and unloading of 2,569,833 tons of merchandise, corresponding to 17.8 per cent. of the total traffic of the port. This represented some 440 tons of merchandise for each metre of quay, implying limited use of port facilities. This is explained by the fact that the installations were not at that time very complete and also that the two largest piers were entirely occupied by the large steam power stations of two leading electricity companies, the coal for which was unloaded in the intermediate basin.

(b) The North Basin and the Docks constitute another section of the port which practically forms part of the city between the Plaza Britanica and the Calle Brasil.

The North Basin is of trapezoidal shape and has an area of about 15.5 hectares, being bounded on its four sides by some 1,100 metres of quays, giving a depth of water of 10 metres (33-ft.), in direct communication with the Entrance to the Port through an opening 80 metres wide on its eastern flank and with the adjacent Dock (No. 4) having an opening 20 metres wide, closed by double gates of the marine lock type. These gates, together with those between Dock No. 1 and the South Basin, were installed for the purpose of isolating the docks and for adjusting variations in the water level of the river; these purposes were never achieved, because of the inconvenience that they would have caused by interrupting communication between the Outer Harbours, with the result that the basic conception of this particular section of the port failed completely, and the present layout cannot in any respect be justified today.

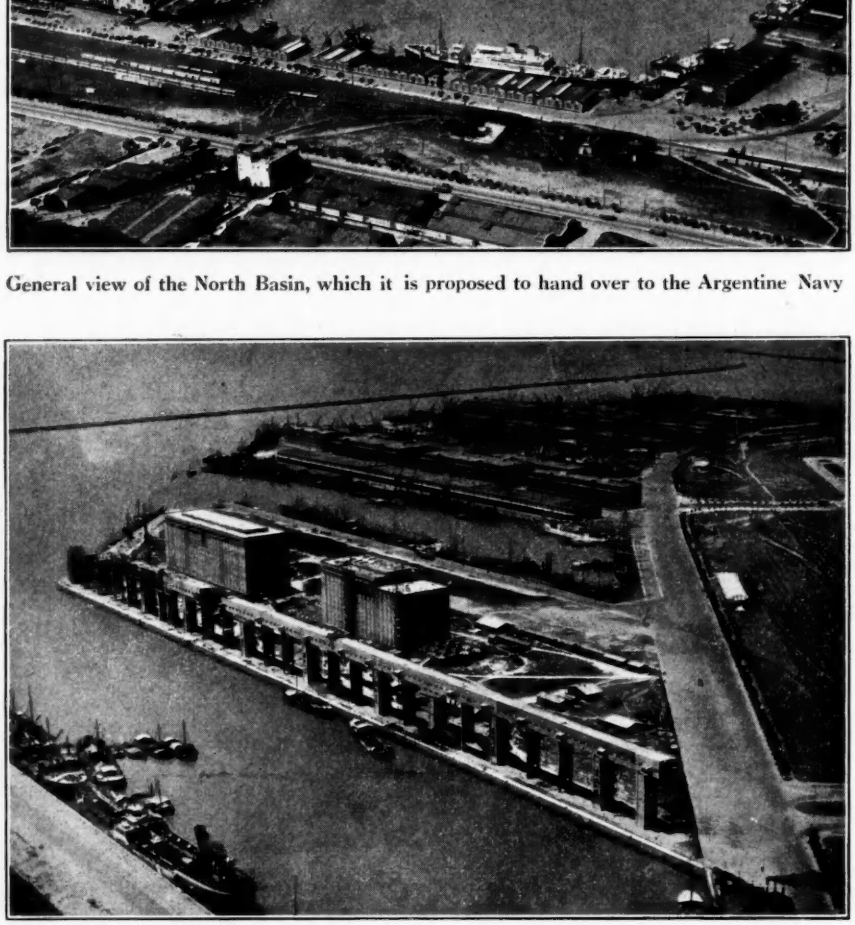
The North Basin is mainly devoted to the service of ocean passengers, their number having reached a maximum of 103,000 in 1937. A limited cargo traffic is also handled in this Basin, consisting of the cargo carried by the large passenger liners. The maximum cargo tonnage handled in the same year amounted to 407,201 tons of goods loaded and unloaded. This Basin has a very important function to perform, not only because it is the legitimate maritime station, but also because it incorporates the most essential equipment to deal with passenger traffic; at present the movement of passengers is completely inadequate.

*Translated and abridged from " La Ingenieria " for November, 1945, by Rolt Hammond, A.C.G.I., A.M.Inst.C.E.



Buenos Aires, as it appears to the traveller arriving by sea

General view of the North Basin, which it is proposed to hand over to the Argentine Navy



The New Harbour—a modern section of the Port, planned and carried out on scientific lines.

Proposed Development Plan for the Port of Buenos Aires—continued

The docks consist of four closed basins, rectangular in plan, laid out in a north-south direction, each joined to the other by narrow entrances, crossed by swing bridges at street level in order to maintain the flow of road traffic between the city and the port district. Each dock is 160 metres wide and its length varies from 570 to 690 metres, making a total of some 6,000 metres of quays with a depth of 7.30 metres (24-ft.). The existing installations, such as sheds, warehouses, grain elevators, mechanical plant and sidings, are adequate but somewhat antiquated. The traffic through the docks, which receive ocean ships like the New Harbour, is limited to vessels of small draught; this traffic reached a maximum of 4,121,565 tons of goods loaded and unloaded in 1936, representing 28.5 per cent of the total trade of the port, with an output of 700 tons per metre of quay.

(c) A third section of the port is composed of the following: the South Basin and the moles of Barracos and Riachuelo, devoted mainly to river and coastal traffic.

The South Dock follows immediately after Dock No. 1, with which it connects by means of a lock. It is rectangular in plan, 100 metres wide and 930 metres long, with 2,240 metres of quays, of which about 1,000 metres are in the form of pitched slopes, the remainder being quay walls giving a depth of water of 6.65 metres (22-ft.). The quays of Barracas and Riachuelo are extended on both banks of the watercourse of that name, having a length of more than 600 metres and giving a depth of water of 7.80 metres (26-ft.). Owing to the nature of the traffic handled, this section of the port deals with a very large number of vessels of small tonnage which convey passengers and cargo between the Federal Capital and the Uruguayan coast and upon the great rivers.

Passenger traffic in the South Basin amounted to 450,000 arrivals and departures, of which more than 360,000 travelled between Buenos Aires and the Uruguayan ports. The maximum cargo traffic was registered in 1936, when 1,304,017 tons were handled by the South Basin and 2,954,776 by the moles of Barracas and Riachuelo; this total of 4,258,793 tons represented some 30 per cent. of the port's traffic. The corresponding output of some 600 tons per metre of quay can be considered as very high in view of the small vessels and inadequate quay facilities, and it is thought that this is a strictly uneconomic development.

(d) A fifth section of the port, lying to the south and within the Province of Buenos Aires consists of the South Dock, a concession operated by a private company, who have exploited the port works and have developed the adjacent land. From the technical point of view, the South Dock consists of a canal some 4,000 metres long and 100 metres wide, giving 6,000 metres of banks, half of which are provided with quay walls, giving a depth of between 8.10 and 8.40 metres of water (27 to 28-ft.).

Vessels of large and medium tonnage use this section, where coal and other raw material are unloaded, cereals and meat being loaded, with very high outputs obtained in both cases. The maximum traffic in 1936 was 3,134,298 tons, with an output of nearly 1,000 tons per metre of quay wall efficiently employed. In addition to the

Proposed Development Plan for the Port of Buenos Aires—continued

above principal sections, there are also the following:—

A Basin for inflammable material, sited in the South Dock, with installations for the storage of petrol and its derivatives. There is also a North Entrance Harbour near the first quay of the New Harbour, the North Basin and other outer harbour defences, and a South Entrance Harbour between the South Basin, the South Dock, near the mouth of the Riachuelo. Finally, there are the entrance channels to the outer harbours with a total length of 50 kms. and a width of 100 metres, dredged and maintained to ensure the passage of vessels with the necessary draught.

II.—General Requirements of the Study.

As I have pointed out already, the city planning of Buenos Aires will have a profound effect on the layout of the port, which must conform to both functional and aesthetic requirements, clearly evident from the very beginning of our investigations. Undoubtedly the subsequent study of the problem from the technical aspect has led us to a perfectly analagous conclusion whereby we have been convinced that the required reforms would not only have to conform to the city's requirements, but would also have to satisfy grave and urgent needs of a technical character.

It was considered indispensable to the plan that many grave deficiencies of the quays should be eliminated and that the programme of future extensions must be based on rational premises, which would ensure the efficiency of the port for a long time ahead.

The following are the fundamental criteria guiding the development of the port:—

(a) The Docks, planned and carried out fifty years ago, are now completely inadequate to meet the increased size of modern vessels, and are thus less susceptible to rational and economic development, not only by reason of the restriction which they impose on the movement of vessels, due to their interdependence, but also to the inadequate wharfage provided, in itself a grave handicap.

It is common knowledge amongst the port officials that sooner or later the docks must be demolished and replaced by open basins, conveniently sited and with adequate depth of water.

(b) The port's most serious deficiency is lack of facilities for handling ocean passenger traffic, and this can be confirmed by anyone who cares to study the arrival and departure of a large ship, more particularly on a rainy day.

The North Basin, at present devoted to this service, is not capable of meeting its requirements adequately; due to its shape, dimensions and siting, it is only with great difficulty that the complicated manœuvres of large and numerous vessels can be carried out at its quays.

In order to solve this problem, it is considered essential to abandon this site and to build a new series of well sited and thoroughly equipped moles for the service of ocean passengers. There must be a maritime station worthy of Buenos Aires.

(c) The very important coastal and river traffic is at present developing in a most chaotic and uneconomic manner over a very wide area, provided with quays of low efficiency. There have been many opportunities of witnessing the need for radical improvement of this state of affairs, and recently the General Directorate of Navigation and Ports of the Ministry of Public Works studied a project which envisaged the construction of a new port for river and coastal traffic, where it has been proposed to concentrate all the traffic using the quays of Barracas and Riachuelo.

The plan that we have proposed completely eliminates these deficiences and assures at the same time that the city shall be independent of port works and installations, both now and in the future, owing to the proposed construction of three distinct groups of quays:—

(a) The necessary quays to replace the docks will be provided for by the extension of the New Harbour, to which will flow almost the entire ocean mercantile traffic, with the exception of certain goods which will be handled in special sections.

(b) The quays, which must supersede the North Basin, embracing all services necessary to the movement of large vessels, are disposed in the North Entrance Harbour, well sited both with respect to the convenience of travellers and in order to meet navigational requirements.

(c) The South Dock and the moles of Barracas and Riachuelo will be superseded by an entirely new port devoted to river and coastal traffic; this will be adjacent to the South Entrance Harbour and will use an embankment on which port works have already been built.

In the following paragraphs we shall review briefly the principal features of these three main works. In particular, we have advised that only the general layout of the new plan should be definitely established, and that the details contained in this review and in the plan are of an entirely general character. In effect, the details of specific works will be established for each individual case, after a very detailed study has been made to consider those technical and economic factors which have a bearing on the construction and development of the works.

III.—Proposed Works

(a) **Extension of the New Harbour**

The extension of the New Harbour will supersede some 5,000 metres of quay at present available to traffic in the four docks, new embankments being formed to gain access to the river in front of the actual basins.

It is at once evident that we expressly avoid the apparently simpler solution of extending the system of existing basins to the north-east, in order to limit the zone of contact between the city and the port, thus preserving the view of the river from the Palermo Park and from the beautiful " Costanera," one of the most delightful districts of Buenos Aires.

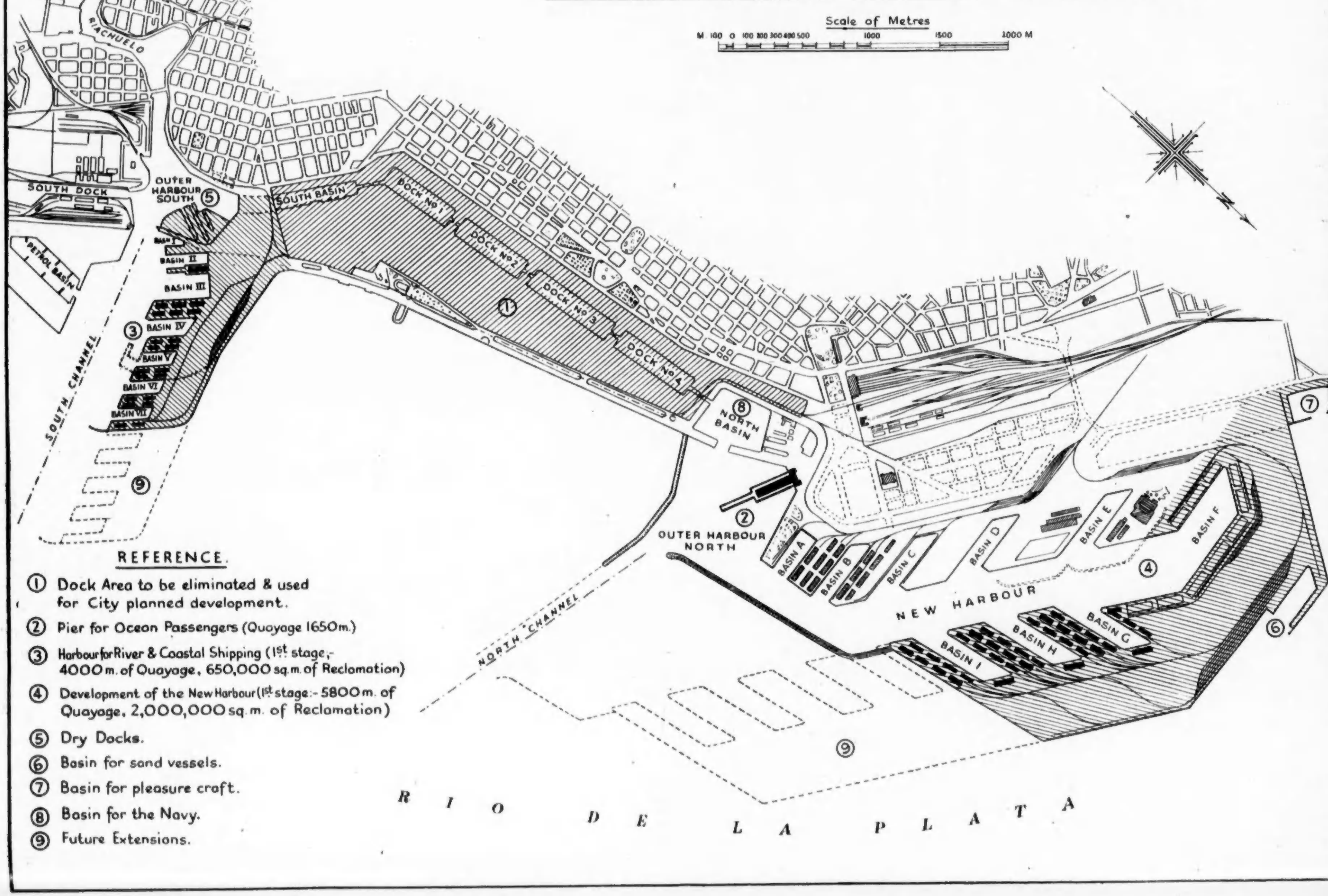
The new quays are located in four basins, namely: three (G, H, I) are similar to the existing ones and are located opposite to them, lying in a north-south direction, and one (F) is on the embankment bordering the port on the north-east, uniting the two opposite sides or wings formed by the piers already in operation and by the new ones yet to be built. The basins G, H, I are each 165 metres wide and 600 metres long, with the exception of the north end of basin G, which is 420 metres long; basin F, in the form of a wide open quadrilateral, has an area of 23 hectares and provides on its four sides wharves of 600, 450, 500 and 550 metres in length. The new works will create some 5,400 metres of greatly improved quays, capable of the most intense development and adequate to deal with a much greater traffic than is at present handled by the docks. The embankments for the new basins will extend to 280 hectares.

Between the two " wings " formed of the old piers and new there is an expanse of water 350 metres wide, which, being a continuation of the approach channel, leads to the separate basins and serves both for the passage and for the manoeuvring of vessels. The existing large electric power stations should not be affected in any way by the projected widening, although it would have been preferable to transfer them to the South Dock district, which would have the double advantage of low property value as compared with the northern part of the city, in addition to being close to the large industrial districts.

Reference to the plan of the extended New Harbour shows clearly that one of its most favourable points will be the ability to concentrate many port services in their own special sections within a comparatively restricted area; these services are at present being developed under very difficult conditions. In particular, it should be easy to differentiate clearly between quays for export and import cargoes, providing both types with the most suitable equipment; this distinction is nearly always desirable in large ports, but is almost indispensable for Buenos Aires, where exports and imports are of an entirely different character.

The existing basins A, B, C, D, with moles 3,750 metres in length, where large grain elevators are under construction, could be used for export traffic, the greater part of which is cereals; the new basins, G, H, I, and the north side of basin F, with 3,900 metres of quays, will handle various imports. Finally, basins E and F, with 2,550 metres of quays, are reserved for coal traffic. Basin E is used by the larger power stations and F is a public basin.

PLAN SHOWING DEVELOPMENT PROGRAMME FOR THE PORT OF BUENOS AIRES.



Proposed Development Plan for the Port of Buenos Aires—continued

Taking into account the nature of the cargo to which this section of the port will be devoted (coal and cereals representing more than 50 per cent. of the total), it can be clearly seen that the combined length of 10,200 metres of quays, when once they are provided with all necessary equipment, will be suitable for handling a much greater traffic than the present combination of the New Harbour and the Docks (6,691,398 tons in 1936), and will be able to fulfil its tasks for a long time to come. Later, extensions should be immediately possible and practically limitless, when new basins are built and new embankments added to those that can at present be foreseen.

Madero Harbour, an irrational expression of port technique, which neglects the needs of the city

(b) **Service for Ocean Passengers**

The principal work involved in this new section of the port, destined to the service of ocean passengers, consists of the construction of a large pier between the North Basin and basin A, with its centre line bisecting the angle formed by the external walls of these basins. This pier has a length of 550 metres, the landward half being 300 metres wide and the outer half having a width of 250 metres. This pier is capable of accommodating four of the largest liners in existence and should be amply sufficient to deal with the passenger needs of the Port of Buenos Aires. From any point of view, this great maritime station, provided with all necessary equipment for handling passengers and located in a beautiful part of the city, will be worthy of receiving the large number of travellers who will visit the Republic from all parts of the world.

Another work to be built for the better service of ocean passengers is the construction of a long quay on the south side of the first pier of the New Port, at present merely a slope. This quay will provide mooring for those vessels which do not require to go to the commercial section of the port, after discharging their passengers, and will also have the effect of leaving moorings vacant at the passenger pier. Should it be necessary, it would be easy to transform the outer face of the north wall of the North Basin into a subsidiary quay, with a length of some 400 metres. At the same time, the 1,200 metres of quay—badly sited and sparsely equipped—at present provided by the North Basin, will be replaced by some 2,000 metres of perfectly sited and convenient moorings, capable of providing excellent service.

In order to conform with the most rational ideas of port development, services for passengers arriving will be completely separated from those provided for passengers setting out on their voyage, because their requirements are completely different. The north side of the passenger pier will be reserved for disembarkation, and the south side for those who are going on board. The vessels arriving to disembark passengers must be manoeuvred easily; as soon as this operation has been completed, the vessels should then leave the pier. Some will go to the basins of the commercial port, in order to discharge the considerable quantity of cargo which they carry in addition to passengers; others will occupy the subsidiary quays nearby, in order to ship provisions for the return journey.

(c) **Harbour for River and Coastal Shipping**

The third fundamental element in the planning of the Port of Buenos Aires has been the subject of study by the General Directorate of Navigation and Ports, who planned a complete and detailed project of the river and coastal port to be developed in the districts near the Boca and the South Basin. This project cannot be considered as satisfactory from the point of view of city planning, taking into account not only present needs, but also those likely to arise in the far distant future. Moreover, far from improving the already unsatisfactory conditions in this part of the city, these will become a great deal worse, the suburb of the Boca being invaded by an extension of more than 20 hectares, where city buildings will have to be demolished in order to make room for new basins and embankments.

In laying down the scheme for this new section of the port, we have followed the general lines of this project, in so far as it refers to the works which have to be constructed, but we are selecting sites for their development which we consider are much more convenient and economical from the city planning point of view. The New Harbour, instead of invading the boundaries of the city, will occupy a zone situated immediately outside the mouth of the South Entrance Harbour, sited for the greater part on an embankment already surrounded by walls; the scheme of construction will at the same time make use of works already completed on the site and will ensure provision for future expansion.

The New Harbour district will be in full and direct communication with the city by means of an embankment across the South Basin, upon which roads and railway sidings will be laid, having sufficient capacity to meet the needs of heavy dock traffic.

As indicated in the plan, the new moorings have been disposed in seven basins separated by six parallel piers, which form an extensive comb parallel to the centre line of the South Channel. First, from west to east, there is a small basin of trapezoidal form with two lateral jetties of 160 and 100 metres length respectively, provided with a mobile transfer bridge for ferry-boats and passengers from there to Colonia, in the Republic of Uruguay.

Basins II and III, which follow, will concentrate upon all the passenger service of the great rivers Parana, Paraguay and Uruguay, the South Atlantic coast, Montevideo and Colonia, and it is therefore proposed to build between them a special pier providing four mooring quays, each with a length of 150 metres, able to provide the necessary facilities for the embarkation and unloading of passengers. This pier will be provided with a maritime station equipped with all necessary facilities, but of limited size in view of the service to which it will be devoted. In fact, the annual movement of passengers has reached a high figure and in 1941 it was stated to have been about 450,000, handled by a great number of small vessels providing five or six arrivals and departures every day, with the result that the flow of passengers at any given moment is never great. Furthermore, the great majority do not carry much luggage and therefore the arrangements for customs inspection—however carefully it may be carried out—requires neither too much time nor too much space.

Finally, due to the predominantly local nature of this traffic, no questions of international prestige arise, for these often result in maritime passenger stations being built on a grander scale than would be reasonably justified for them to meet every requirement. Another small building at basin I will be employed for the passenger service running from there.

The other quays of basins II and III will provide some 900 metres of moorings for passenger or mixed cargo vessels during their stay in port. In order to load and discharge cargo and to carry out manoeuvring and provisioning, the vessels should lie

Proposed Development Plan for the Port of Buenos Aires—continued

alongside the passenger pier only for that time which is absolutely essential for the embarkation and unloading of passengers.

Basin IV, in the form of a large rectangle, with two mooring moles each of 350 and 275 metres length, is reserved for the loading of fish and fruit, and for this purpose refrigerated stores will be provided. In another part of the port works, according to the project of the Directorate General of Navigation and Ports, a large fruit and fish market will be provided. Basins V, VI and VII, each 250 metres long and 100 metres wide, with a total combined length of quays of 1,500 metres suitable for the most intense development, will be fitted out to deal with part of the traffic at present handled by the quays of Barracas and Riachuelo.

Only a minute study of port movement in any particular zone can determine which existing river quays should be efficiently maintained, and which should be eliminated, when transferring traffic to the new river and coastal port. According to the present plan, this offers a combination of more than 3,600 metres of excellent quays, adequately equipped to supersede the South Basin, the quays of Barracas, and at least half those at Riachuelo. Greater developments, if necessary, could be realised immediately by the constructioun of new basins as shown by the dotted outline; on the other hand, in the first instance, it would be possible to carry out a more restricted plan by cutting out Basins V, VI and VII.

With the realisation of the three main works outlined above, we consider that the city planning problem will be completely resolved. The North Basin, the Docks, the South Basin and the quays of Barracas will be superseded by new installations and will be eliminated from the layout of the port, whilst the adjacent land (the entire zone to the east of the Avenida E. Madero, L. A. Huergo and P. Mendoza) will be entirely freed from the port and can be developed in the most suitable manner. Neither does the future development of the quays, so far as can be seen at present, raise any difficulties.

We also believe that we have provided an organic solution to the technical problem of the revised planning and extension of the port, and in order to complete this we have only to consider certain other works vital to the layout of the port.

(d) **South Dock**

An important and very intense traffic is concentrated in this section of the port, provided with adequate moorings and with the following installations, which include: silos for cereals, refrigerated warehouses for meat, coal stores, etc., and everything necessary for reasonable development. If it should be necessary to increase the capacity of this section, it would be sufficient to build quay walls on both banks of the canal, in accordance with a scheme put forward some time ago.

(e) **Graving Docks**

The Port of Buenos Aires at present suffers from a grave deficiency in the means for repairing and maintaining vessels, and there are only two dry graving docks, one having a length of 180 metres and the other of 140 metres, sited on the north-west flank of the North Basin, in addition to a floating dock 100 metres long, with a lifting capacity of 4,000 tons.

There is thus a very great need for the necessary repair facilities to maintain the vessels which use the port, and, if in the past this was a problem when almost every ship was foreign and could find the necessary facilities for repair in other ports, it can at present be considered intolerable that this state of affairs should continue in a country having its own merchant navy. Moreover, according to the proposed plan, the graving docks of the North Basin will be reserved for the Argentine Navy, so that it is necessary to decide where the corresponding facilities should be provided for the commercial port.

A very convenient zone for this purpose is that adjacent to the new coastal harbour, in front of the entrance to the South Dock, that is at present occupied by some buildings of the Ministry of Public Works, which can be transferred elsewhere.

This zone has features very suitable for its new purpose; it has enough width to allow of the construction of three or four docks of the larger type; it is surrounded by a vast expanse of water, well protected against wave action, and after the demolition of the quays at the South Basin the traffic will be greatly reduced.

(f) **Basin for Pleasure Craft**

In order to meet the well understood needs of keen yachtsmen, it is proposed to build a special basin, siting it near the embankment which closes the northern end of the New Harbour. The basin, flanked on the east by a defence wall 200 metres long, will have a quay 150 metres long for the mooring of boats on the embankment of the New Harbour, and another 200 metres long within the beautiful Costanera, where buildings will be erected for various clubs and associations.

(g) **Basins for Sand Vessels**

The traffic in sand and quarried stone—the greater part of which comes from the Republic of Uruguay—is extremely important for the Port of Buenos Aires, amounting in one year to as much as 400,000 tons. This traffic has developed in Barracas, but in order to reduce transport charges, which have an important influence on the price of these materials, it would be convenient to provide two unloading berths: one at the South Harbour and the other at the North Harbour. As far as the former is concerned, we believe that it will be convenient to maintain the existing site, since the importing firms have established themselves in the district; whereas for the latter, it is proposed to construct a special basin, near the New Harbour, provided with the necessary facilities for its particular task.

(h) **Communications Between Various Sections of the Port**

As soon as this proposed plan has been put into effect, the Port of Buenos Aires should consist of two distinct portions at a considerable distance from one another: the ocean harbour to the north, and the river and coastal harbour to the south. This division of the port district does not lack certain inconveniences, but it must be considered as inevitable for any transformation of the port, which must conform to practical needs. This division is precisely due to the present situation, where there are two principal groups of moorings: the New Harbour to the north and the quays of Barracas and Riachuelo to the south, around which conditions have arisen which have influenced the very life of the city and would be practically impossible to modify.

At present this separation is less evident, owing to the existence of the docks, which provide a certain continuity between the two sections, but once the docks have been demolished no vessel whatever will be able to pass from one port to the other without traversing the entire lengths of the North and South Canals. In order to avoid this inconvenience, an outer canal has been projected, running parallel to the coast and having a length of 4,000 metres, connecting the north-west and south-east extremes of the port. Maritime and river traffic should develop intensely along this canal between the North and South Harbours, under conditions much more satisfactory than those at present obtaining, since the slightly longer journey will be compensated for by the great advantage of navigation in free waters, without the handicap of stops or of excessive limitations of speed.

As far as railway traffic between the zones is concerned, this could be arranged along the portion which borders the city, or by means of a direct subway line to be developed so that it will not interfere with traffic or amenities. The former would be the most economical solution from a constructional point of view, but it would be very long, with all consequent inconveniences; the latter would be very short, but its first cost would be high. The problem of choosing one or the other solution is only outlined here; in due course this will have to be faced and solved on the basis of a complete knowledge of the nature and volume of the traffic to be handled.

IV.—Order of Carrying Out the Works

One particularly important question in the execution of this proposed plan, is the order in which the works shown on the layout should be undertaken, bearing in mind not only their relative urgency, but also their subsidiary effects. In order to avoid unnecessary interference with port activities during the course of the works, and in order to obtain the maximum value from the different elements of the complete scheme, these considerations must be kept in view.

We consider that the following scheme will provide the most

Proposed Development Plan for the Port of Buenos Aires—continued

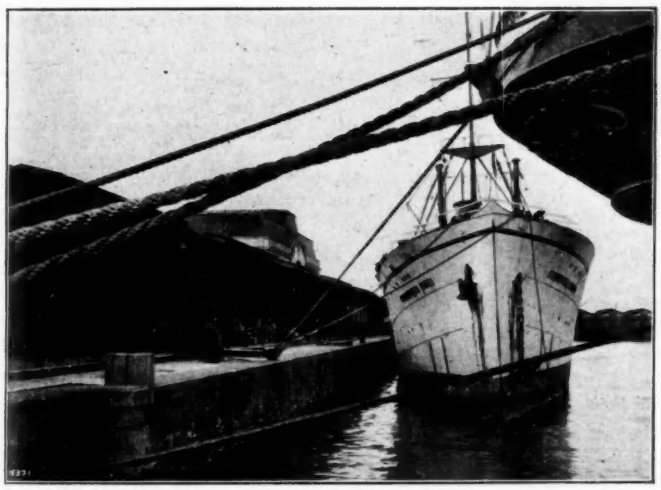
convenient order of works, each stage being more or less dependent upon the financial position.

First Stage.—Construction of the maritime station for ocean passengers, and the subsidiary quays in the North Entrance Port.

This is undoubtedly the most urgent need of the Port of Buenos Aires, and the relative works can be carried out without interfering with the normal traffic, in view of the size of the Entrance Harbour and the presence of sufficient area to accommodate plant and machinery. As soon as the new station has been finished, and the services from the North Basin transferred to it, it should be completely free to handle a large part of the traffic which to-day taxes the capacity of the South Basin during the whole period required for carrying out the works proposed for the second stage.

Second Stage.—Construction of the river and coastal harbour.

This part of the plan is also urgent in view of the need for ending as soon as possible the existing chaotic development of a very important traffic. The relative works in this zone can be carried out quickly, and with practically no hindrance to port services.



North Basin, where passengers at present arrive and depart

The only difficult feature is the formation of the connecting embankment between the river port and the city, across the South Basin, near the south-eastern end of the latter, the presence of this preventing direct access to the Basin which connects only with Dock No. 1. It has therefore been proposed at this stage to transfer to the North Basin a large part of the traffic which would normally have to be handled by the South Basin until the new river and coastal port would be in a position to fulfil its functions.

The elimination of direct communication with the South Entance Port will also result in a corresponding throttling of activity in the docks, which ought to be efficiently maintained until the end of the works for the third stage of development—the construction of the New Harbour. Thus, boats which to-day enter by the north and leave by the south—or vice versa—without changing their route, owing to the presence of this embankment, will have to undergo a complete change in position before overtaking other vessels or when leaving the docks.

In view of the ample width of the docks and the relatively small dimensions of the vessels which use them, we consider that this will not be a very serious inconvenience. If for any reason it should be found essential to maintain access from the south while the docks continue to operate, it would always be possible to build an embankment with a swing bridge at road level, similar to those which already exist in the present dock system, alternating the periods of land communication between the coastal harbour and the city with those of river communication, between the South Basin and the alternative Outer Harbour.

Third Stage.—Construction of the Basins in the New Harbour.

This part of the work presents very few difficulties, owing to the recent experience gained, and also to the fact that the new works are exactly similar to those already in existence. In view of the wide variety of work, this will also proceed by stages, warehouses, cranes, railways and roads being erected and built according to traffic requirements.

V.—Conclusion

The realisation of the vast plan which we have just reviewed should have the following results:—

(1) Complete transformation of the ocean cargo harbour due to the elimination of old and unsuitable equipment, substituting for these new basins and wharves of high efficiency, laid out in the form most suitable for ensuring complete development. At the same time, all ocean merchant traffic will be concentrated in a single zone, with the exception of certain specialised goods, with obvious advantage.

(2) Adequate service for ocean passengers, by the construction of extensive quays and of a very modern maritime station in keeping with the reputation of Buenos Aires.

(3) Creation of a new section for concentrating all river and coastal traffic, at present scattered over a wide area and making use of various independent quays, nearly always badly sited and sparsely equipped.

(4) Possibility of practically unlimited extensions, as much for the ocean as for the coastal harbour, on clearly established lines which will ensure the complete independence of the city centre in relation to the port zones, simultaneously with the solution of the technical problem both now and in the future.

(5) Elimination of all port works and installations within an area of more than 150 hectares, which is at present within the confines of the commercial centre of the city, and therefore has a high econmic value which will enable the most intense development to be justified.

Before concluding, let me say a few words about two objections which will certainly be raised against this plan, namely, damage to vested interests and the cost involved. We are well aware that the solution which we propose will affect some private interests, such as those who have developed port facilities in districts which will now have to be abandoned, but the great advantage to the general interest of efficient planning of the port will more than offset any slight loss thereby incurred. Every possible effort will be made to avoid unnecessary changes with the object of speeding on the work, bearing in mind the prime necessity of not sacrificing in any way the harmonious and reasonable development of the plan. The granting of concessions in the past has led to inadequate and unreasonable solutions of the port problem, of which, unfortunately, the present port is an example.

As regards the capital cost of this proposed plan, we are not yet in a position to give this, owing to the general character of the survey so far carried out, but we can state that it will be considerable, not so much because of the expense of individual works, but mainly by reason of the special conditions of construction or siting.

Furthermore, we have insisted that it is not necessary to carry out all the proposed works, but only those which are in fact absolutely urgent and indispensable, namely: the ocean passenger station and the new coastal harbour, which represent the first and second stages of our plan. The cost of these works, carried out in the form that we propose, will not be greater than any other solution of the same efficiency.

In future, when further development of the docks can no longer be continued owing to technical and economic difficulties, then the third and most costly stage of the plan will be undertaken—the extension of the New Port. In estimating the cost of this work, it must be borne in mind that the value of the land freed from port works will be greatly enhanced from a commercial point of view, and this will do much to contribute towards the cost of the work.

Notes of the Month

The Trinity House.

At the annual court of the Corporation of Trinity House recently, the Duke of Gloucester was re-elected Master and Captain Sir Arthur Morrel was re-elected Deputy Master for the ensuing year.

Discharge Rates at Belfast.

The Belfast Harbour Commissioners have decided that as from July 1st the rates for the use of small discharging cranes up to 10 tons capacity should be increased by 33⅓ per cent. instead of 20 per cent. as at present. The working of these cranes during the past four months has resulted in a loss.

Richmond Lock Re-opened.

Richmond Lock, on the River Thames, was re-opened for the passage of vessels on June 12th last. The lock was damaged by enemy action in February, 1944, in an attempt to cut London's petrol supply, which, at that time, was being conveyed down river by tanker barges from the Severn to Thames pipe line which terminated at Walton-on-Thames.

Reduction in Port Dues in Belgium.

In conformity with the policy adopted by the Belgian Government to bring about a general reduction in prices, improve the buying capacity of the Belgian franc and stop the threatening inflation, a general decrease of 10 per cent. in all prices has been decreed. As a result, all port dues and taxes in Belgium were reduced by 10 per cent. as from the end of May.

Swansea Dockers Transferred.

Under the labour transfer scheme, 120 unemployed dock workers have been transferred from Swansea to Southampton. There is a scarcity of tonnage for the general cargo trade at Swansea Docks and the dock workers say that the ships should be sent to the port instead of transferring men elsewhere. Officials of the Transport and General Workers' Union have stated that the scheme is proving very successful.

Free Port Suggested for the United Kingdom.

Mr. Hugh Dalton, Chancellor of the Exchequer, was recently asked in the House of Commons whether enquiries are being made as to the advantages of a free port in the United Kingdom, and if he was in a position to make an announcement on the matter. In a written reply, Mr. Dalton said he was looking into the question in consultation with the President of the Board of Trade and the Minister of Transport.

Belfast Graving Dock Caisson.

At a recent meeting of the Belfast Harbour Commissioners, a report from the harbour engineer was submitted stating that he had ascertained that the provision of a new caisson for the Thompson graving dock would cost at least £50,000, and that the time required for its construction would be from eight to nine months. As the graving dock would not be required for the next few weeks, and the Admiralty floating dock would be available, it was agreed that the present caisson should be placed in the floating dock for examination and repair as soon as possible.

Visit of General Lee to United Kingdom Ports.

Lieut.General John C. H. Lee, former Commanding Officer for American Supply Services in the European Theatre, visited this country during June and conducted a week's tour of United Kingdom Ports. The purpose of the tour was to thank port workers for the part which they played in the two biggest invasion operations of the war—the landings in North Africa and the invasion of Europe. General Lee met the Minister of Transport, Mr. A. Barnes, M.P., and was also the guest of H.M. Government at a dinner at Lancaster House. His itinerary included visits to Bristol and Avonmouth, Dartmouth, Plymouth, Southampton, Liverpool, Manchester, the Clyde, Hull, Immingham and South Wales. During his tour, General Lee bestowed the Medal of Freedom on the former Regional Port Directors and also addressed the dockers at each port.

Polish Mine-Clearing Operations.

An agreement was recently concluded between the Polish and Russian navies whereby the work of clearing mines in the vicinity of the Ports of Gdynia and Gdansk is to be continued. It is reported that specially-equipped Russian trawlers have arrived in Polish ports to assist in the work.

Port of Liverpool Staff Changes.

At a recent meeting of the Mersey Docks and Harbour Board, Mr. E. Gardner, the Deputy Chairman, announced the retirement of Mr. M. R. Preston, M.B.E., the Deputy General Manager and Secretary, who has spent nearly 50 years in the service of the Board. Mr. F. H. Cave succeeds Mr. Preston as Deputy General Manager and Secretary.

Newport Harbour Commissioners.

Having been informed by the Admiralty that the whole of the Bristol Channel has been cleared for navigation, the Newport Harbour Commissions are to consider the advisability of restoring the light at Goldcliff Point. They are also contemplating the resumption of their annual inspection of the River Usk which was suspended during the war.

Tees Conservancy Commission.

Mr. A. V. Buttress, engineering assistant with the Tees Conservancy Commission for 22 years, has been appointed river superintendent. He is a member of the Institute of Structural Engineers. Mr. M. J. Blackford, of Bristol, has been appointed dredging superintendent in succession to Mr. H. R. Fiddes, retired.

Morpeth Time Gun.

The time gun on Morpeth pierhead, Liverpool, which last fired on September 1st, 1939, resumed firing on June 17th last. The Mersey Docks and Harbour Board obtained a new gun from the Admiralty, and the necessary electric circuits have been arranged so that the gun may be fired on a signal from the Bidston Observatory. The gun will continue to fire at 1 p.m. civil time each day, public holidays and Sundays excepted.

United Kingdom Pilots' Conference.

The 59th conference of the United Kingdom Pilots' Association will be held at the Holborn Restaurant, London, on Tuesday and Wednesday, July 9th and 10th. Resolutions to be submitted to the conference seek to establish general compulsory pilotage for all ports in the United Kngdom, and to resist efforts to effect reductions in the number of pilots. Pilotage rates, post-war pilotage and the National Insurance Scheme will be among the subjects to be discussed.

Collection of Kiel Canal Dues.

It is announced from London that the United Baltic Corporation, the affiliated company of the East Asiatic Company, Copenhagen, has been given sole authority to collect dues in the Kiel Canal, thus replacing a number of German offices. The Corporation will be agents for all non-German ships sailing through the Canal and will remit the dues collected to the British authorities, who, for the time being, are responsible for the maintenance and working of the Canal. The address will be United Baltic Corporation, Ltd., Kiel, B.A.D.R. Branch offices will be opened later at Brunsbüttel and Flensborg.

Iron Ore Discharging Facilities at Glasgow.

It is reported that the Clyde Trustees, the London, Midland and Scottish Railway Company and companies handling iron ore cargoes at General Terminus Quay, Glasgow, have agreed on the general outlines of a scheme by which vessels up to 12,000 tons could be berthed, discharged and turned round in 30-36 hours. Berthage will be provided at the quay for two ships instead of one, as at present, but the new arrangement will require the removal of the temporary ferry recess to a position farther west. Also, the coaling of ships at the quay will be discontinued. The Trustees have agreed to the scheme provided the work is done to the satisfaction of their engineer and they are relieved of the cost.

Cantilever Retaining Walls

By NORMAN A. MATHESON, M.Inst.C.E., M.Inst.T.

Cantilever retaining walls, generally constructed of steel or reinforced concrete sheet piling, often provide a convenient design for river and sea protection works, shallow embankment walls, and similar structures where the retained height is not great and the stresses in the piling are of moderate value. They possess the distinct merit of obviating the need for walings, tie-rods and anchorages, and thus avoid disturbance of ground and buildings close to the site. A further merit lies in the fact that, as the piling section must be heavy enough to carry all the forces without other support, it will be of heavier section than would be the case with an anchored wall, and accordingly the effective life of the wall is likely to be longer. As a rough example,

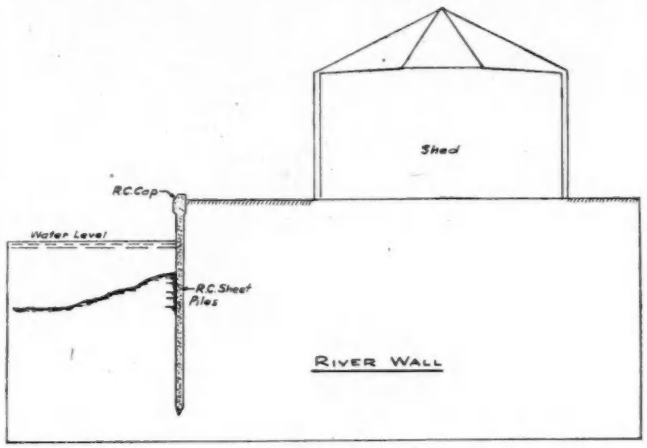


Fig. 1.

whereas an anchored wall might be constructed of Larssen No. 1 GB Section having an effective life of some 40 years, a cantilever wall of equal height might require Larssen No. 2 Section which has an effective life of some 70 years.

Typical examples of cantilever walls are shown in Figures (1) and (2).

In designing a cantilever wall, it is customary to assume that it will rotate about a point some distance below bed level, and then calculate the forces acting on the wall as:—

(a) active pressure behind the wall;
(b) passive resistance in front of the wall;
(c) passive resistance behind the wall below the level of the point of rotation

These forces must produce equilibrium. Since no convenient and simple formula is available for calculating the length of piling required, this is usually determined graphically by "trial and error," the imbedded length of piling being adjusted until the three forces produce stability.

Figure (3) illustrates a line of sheet piling a—b, the top of the sheeting being at ground level, which is the same on both sides of the piling. If a force F, such, for instance, as the pull of a rope, is applied at the top, the conditions set up are assumed to be:—

(i) the wall tends to rotate about some point 0;
(ii) the passive resistance in front of the wall (represented by the area aoc), and the passive resistance at the back of the wall (represented by the area odeb) come into action to stabilise the wall.

As the application of the force F tends to move the wall forwards, and thereby set up an active pressure behind the wall, it is of interest to consider the case depicted in Figure (4), where active pressure (instead of passive resistance) is assumed to act for the full depth at the back of the wall.

The forces now tending to move the wall to the left are F and the active pressure P. To neutralise these, it is necessary to provide an opposing force R, of magnitude equal to F + P, and having its point of application at the centre of gravity of these two active forces.

Let w = weight of 1 cu. ft. of material;
θ = angle of repose of material;
Ca = Rankine's coeff. for active pressure $= \dfrac{1-\sin\theta}{1+\sin\theta}$
Cr = do. for passive resistance $= \dfrac{1+\sin\theta}{1-\sin\theta}$
L = total length of piling required for stability.

Taking moments about the top of the sheeting, Figure (4), it will be seen that

$$P \times L = R \times t$$

from which

$$t = \frac{PL}{R} = \frac{L^3 \times Ca}{t^2 \times Cr}$$

giving $t = L \div \sqrt[3]{Cr^2}$

Since $F + P = R$, then

$$F + \tfrac{1}{2} \times w \times L^2 \times Ca = \tfrac{1}{2} \times w \times t^2 \times Cr$$

from which

$$L = \sqrt{F \div \tfrac{1}{2} \times w \{Cr(\sqrt[3]{Ca^2})^2 - Ca\}}$$

The complicated form of the equation is due to the fact that the force F bears no relationship to the earth forces. In a retaining wall, however, the total loading can almost invariably be related to the height, with consequent simplification of the equation.

Figure (5) shows a wall of sheet piling retaining a bank H feet high. If the total height of the wall is taken as L feet, the penetration of the piles below bed level is (L—H) feet. The active pressure on the back of the piles =

$$P = \tfrac{1}{2} \times w \times L^2 \times Ca$$

and the point of application is at a distance L/3 from the toe of the piling. In front of the wall a passive resistance can be generated =

$$R = \tfrac{1}{2} \times w \times (L-H)^2 \times Cr$$

with its point of application at a distance $\dfrac{L-H}{3}$ from the toe of the piling.

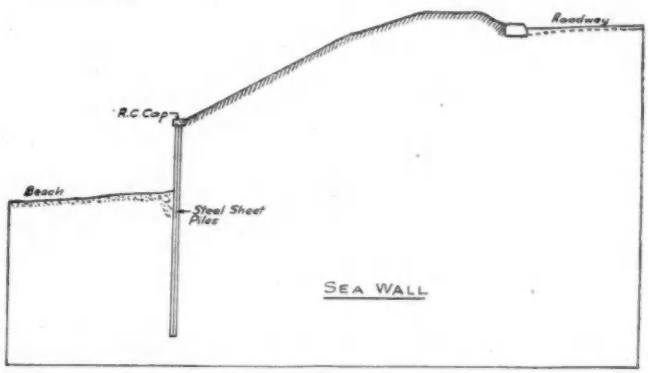


Fig. 2.

But it must be remembered that, whereas the active pressure P is actually present, the passive resistance R is only generated to an extent sufficient to ensure equilibrium.

The simplest means of balancing the force P would obviously be to provide a force R directly opposite and equal to P.

For this to take place, it will be seen from Figure (5) that the following conditions must be fulfilled —

(i) $\dfrac{2t}{3} = \dfrac{2L}{3} - H$: from which $t = L - 1.5H$;

Cantilever Retaining Walls—continued

(ii) $\frac{1}{2} \times w \times t^2 \times Cr = \frac{1}{2} \times w \times L^2 \times Ca$: from which

$$t = L \times Ca.$$

Equating (i) and (ii):— $(L - L \times Ca) = 1.5H$; the total height of wall required for stability is obtained from the equation

$$L = \frac{1.5H}{1 - Ca}$$

The resultant loading diagram is shown in Figure (6), and the stresses in the piling are calculated in the usual way.

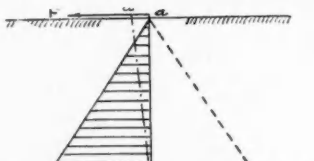


Fig. 3.

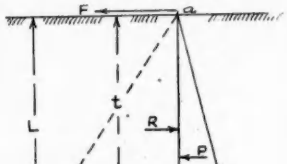


Fig. 4.

The following table gives values of L in relation to H for various angles of repose, and it will be noted that these correspond closely to the values obtained from the usual graphical solution.

Θ	Total Height of Wall = L	Penetration of Piles
20°	2.94 × H	1.94 × H
25°	2.54 × H	1.54 × H
30°	2.25 × H	1.25 × H
35°	2.06 × H	1.06 × H
40°	1.92 × H	0.92 × H
45°	1.81 × H	0.81 × H

In the case of a surcharged wall, where the angle of surcharge is equal to the angle of repose of the material, the total height becomes:—

$$L = \frac{1.5H}{(1 - \text{Cos}\,\Theta \times \sqrt{Ca})}$$

In the foregoing, it has been assumed that the ground on both sides of the sheeting has the same weight and angle of repose.

Generally, however, part or all of the material at the back, or pressure side, of the wall has properties different to those of the material at the front.

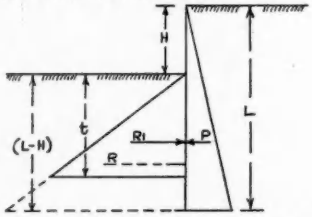


Fig. 5.

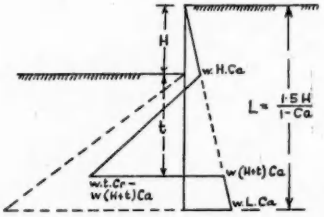


Fig. 6.

Provided the differences are not excessive, the following more general equations can be used as a check against graphical solution:

$$L = \frac{1.5H}{1 - \sqrt{w' Ca' \div w'' Cr''}}$$

For a surcharged wall:

$$L = \frac{1.5H}{1 - \cos\Theta' \sqrt{w' Ca' \div w''}}$$

Where w', Ca' and Θ' refer to the material behind the wall (using the values giving maximum pressures): w" and Cr" refer to the material in front of the wall.

Proposed Airport at Port of Southampton

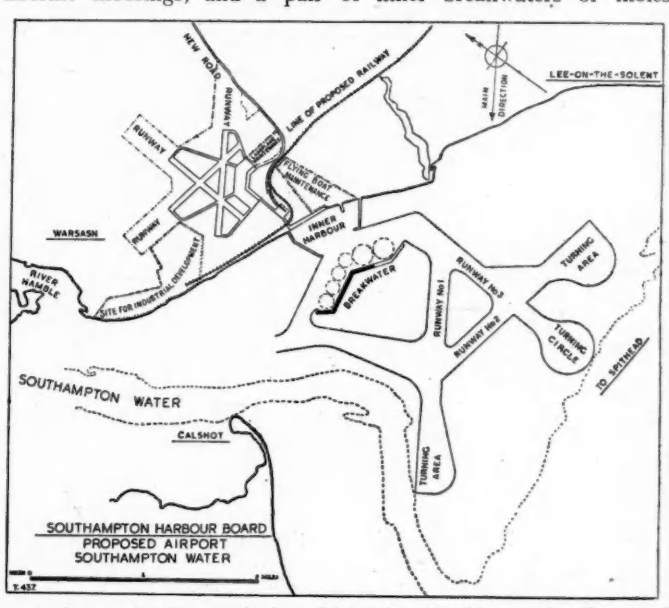
Harbour Board's Scheme

Plans of a proposed airport at the confluence of Southampton Water and the Solent have been approved by the Southampton Harbour Board and the whole scheme has been submitted to the Minister of Civil Aviation, who will select a site for the international marine air base for this country.

The Southampton Scheme is for a Marine Alighting Area situated in the triangle formed by the Lee-on-Solent foreshore, the Western approach to Southampton Water, and the deep water channel of the Solent. Access to the Airport would be by air, rail and road, and in addition, Southampton Docks could be reached by fast motor launch within half-an-hour.

Water runways having a length of 12,000-ft. and a width of 700-ft. are ready for use and no initial dredging is necessary to provide the necessary depth of water for the largest flying boats now under construction. As the alighting area is not landlocked; additional lengths of runway in the alighting area are also available if and when it becomes necessary to provide them.

A mooring basin for flying boats would be provided by a double system of shelter consisting of an outer breakwater covering the aircraft moorings, and a pair of inner breakwaters or moles



enclosing a harbour within which the loading, unloading and repairing of flying boats would take place.

Tidal and meteorological conditions generally are suitable for the operation of flying boats, save that on an estimated aggregate of four days per year rough weather conditions may be prejudicial to such use, and on these rare occasions, it is considered that operations could be carried on behind the shelter of Calshot Spit, or other nearby areas.

With efficient flying control the relatively small amount of shipping interferences would be negligible, and in this connection past experience of the use of the Port of Southampton by flying boats is the greatest justification for the Board's confidence in this statement. During the ten years in which flying boats have used Southampton, and especially during the years 1944 and 1945 when over 2,000 alightings and departures took place, Southampton has been used without accident of any kind. This is all the more noteworthy because the latter period included the months preceding and following " D " Day when a greater number of shipping movements occurred than at any previous time in the history of the port, or than are likely to occur in any peace-time period of the foreseeable future.

As regards access to the Marine Airport by landplane, it has been established that large land planes employed on transcontinental and transoceanic services will be dealt with at the

Proposed Airport at Port of Southampton—continued

London Airport, formerly known as Heathrow. It seems more than likely, however, that a demand will be created for a means of access more expeditious than rail or road, and it has been deemed prudent to make provision for the arrival and departure of smaller land craft employed on feeder lines to be accommodated immediately alongside the Marine Airport. The existing terrain allocated to this purpose is in every way eminently suitable; it has no abrupt changes of slope, and subject to more detailed investigation, the ground appears to be satisfactory for the purpose of constructing the runways, foundations for buildings, etc.

Sites have been indicated for ancillary purposes, such as flying boat maintenance, land plane maintenance, car and helicopter parks and industrial development.

As regards time of construction it is estimated that the nucleus of the scheme could be provided within a period of two years, providing sufficient accommodation for the present known types of flying boat, and so much of the land aerodrome as the Minister may consider desirable to introduce in the early stages, leaving further developments to be taken in hand as and when the traffic requirements develop. As no dredging is required to bring the water runways into immediate use, the major time factor would therefore be the construction of the mooring harbour and such land plane facilities as might be considered necessary.

Calculations show that the initial facilities referred to would cost approximately three million pounds, and that if and when the full scheme is provided, the final cost might amount to a total of five-and-a-quarter million pounds. Broadly, the scheme demonstrates that an international Class " A " Marine Airport conforming to the most modern standards, could be established at the confluence of the Southampton Water and the Solent.

The Tees Conservancy Bill

Proposed New Dock at Middlesbrough

Anticipating considerable development of light industries in the Tees-side area, the Tees Conservancy Commissioners are seeking Parliamentary powers to enable them to construct a new dock in competition to the dock owned by the London & North Eastern Railway Company at Middlesbrough. The Tees Conservancy Bill recently came before a Committee of the House of Commons and formally received approval after the hearing of evidence from the Conservancy Commissioners and also from the Railway Company, who opposed the Bill.

In support of the Bill, Mr. Craig Henderson, K.C. for the Commissioners, stated that the Tees Conservancy Board was formed in 1872 and since then had so improved the river that ships of large tonnage could go right up the river. Realising that the economic progress of the port was dependent on the degree of modernisation, a special committee of local interests was formed a few years ago to make a report upon the matter. The salient defects of the present regime was that the existing dock could only handle cargoes from rail traffic; there was no road access and no road transit sheds; the dock equipment was not suitable for general cargoes and the Railway Company had not instituted any important works of improvement for future needs of new industries.

The Commissioners then asked the Railway Company if they would build a new dock; would they sell the existing dock to the Commissioners or would they carry out all the necessary improvements to bring the existing dock up-to-date. Receiving little encouragement from the Railway Company the Commissioners felt compelled to present this present Bill and asked for powers to borrow up to £5,000,000, which, when the outstanding debt of the Commissioners was finally cleared off next year, would represent their total indebtedness.

Mr. G. West Byng, the Chairman of the Commissioners, gave evidence of the great falling off of the trade of the port over the last 20 years and stated that in his discussions with shipbrokers and industrialists he found that they all considered the port facilities inadequate; there was little room to manœuvre large ships in the dock, and at the gates; the approach channels and entrances were too narrow, and there was an absence of crane and shed facilities.

Outside of the dock there was no deep water quay in the river, although there were a number of wharves in private ownership. Up to the present the Commissioners had been handicapped in general improvement of the economic condition of the port as they had been concerned with purely conservancy matters of dredging and lighting. The Commissioners, therefore, felt convinced that without a controlling authority for the whole river there would be no organised scheme of development.

In answer to Mr. Maurice Fitzmaurice, K.C., Counsel for the Railway Company, Mr. Byng contended that not only were the docks inadequate, but that trade was falling off owing to the cramped condition of the existing dock. He also said that the tonnage expected to be handled by the proposed new dock was 375,000 tons import and 655,000 tons export per annum. He was told that the new dock would take four years to complete.

Mr. E. J. Buckton, M.I.C.E., senior partner of the Consulting Engineers for the Commissioners, stated that he thought the dock in its present state was not only inadequate but obsolescent, as it was originally built for much smaller ships. He estimated the total cost of building the proposed new dock to be about £3,716,800, of which £2,153,400 would be expended on building the basin and wharves. Further evidence from representatives of the Middlesbrough District Association and the Mayor of Middlesbrough supported the Commissioners' contentions.

Mr. Jenkin Jones, divisional manager of the N.E. Area of the London & North Eastern Railway, speaking on behalf of those opposing the Bill, said the Middlesbrough dock was perfectly adequate and there was ample margin for accommodation. In 1929, it handled double the traffic dealt with in 1938, and very nearly three times as much as to-day. He had no evidence of any proposed increase in trade to justify the facilities asked for in the Bill. There were encouraging prospects of new industries being established in the area, but they would be small and light industries almost entirely for the home market. He did not think anyone would seriously contend there would be any substantial export traffic in manufactures of that kind, and the existing dock would be able to handle all future traffic without additional facilities being necessary. A new dock would merely take away traffic from the present dock, where there is already a large margin of capacity, and thus impose a serious financial burden on the whole river.

After due consideration, the Committee's approval of the Bill was announced, and it was also agreed that the Minister of Transport should be asked to nominate a representative of the Railway Company as one of his three representatives to the Conservancy.

Correspondence

To the Editor of "The Dock and Harbour Authority."

Impact Stresses in Jetties

Dear Sir,—

I have read Mr. Jellett's letter in your June issue with great interest. Many of the points he raises I have dealt with in the article on the subject in the current issue.

There are two further points I should like to comment on.

(a) At the present state of our knowledge of the amount of blow energy delivered to any structure on impact it is impossible to say, with any justification, that this or that structure is over-designed. The evidence offered in law cases on damage to wharves and jetties by vessels is illuminating on this point. It also shows the unreliability of the observations of witnesses at the critical time.

(b) Mr. Jellett's suggestion that the subject should be investigated by a body similar to the Bridge Stress Committee has my whole support.

I hope that Mr. Jellett may be able to give us some full-scale observations of the customary procedure at his port.

Yours faithfully,

R. R. MINIKIN.

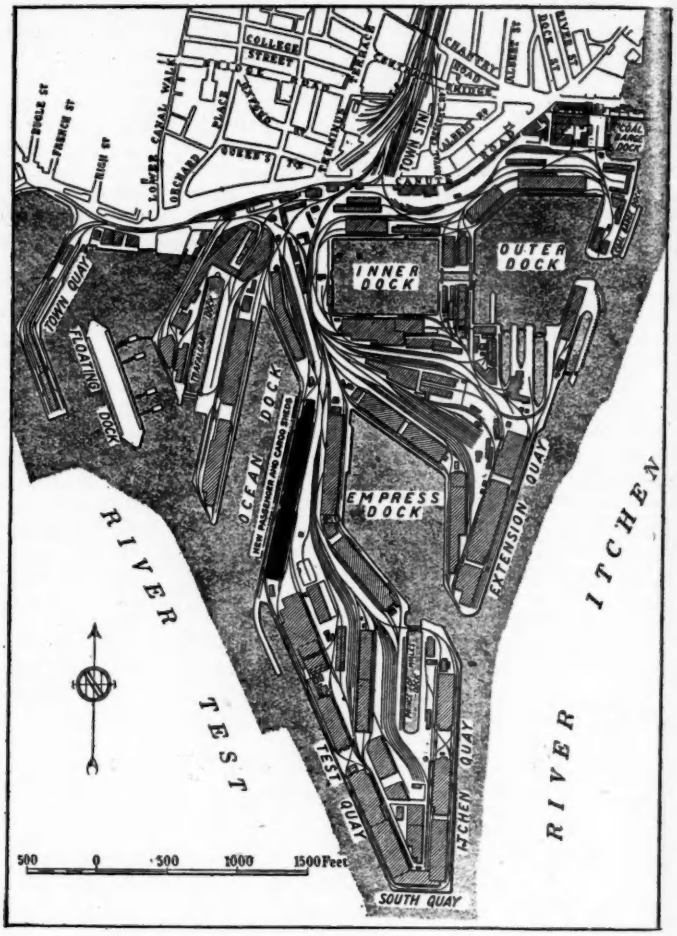
Southampton Docks Improvement Scheme

Ocean Dock Facilities to be Reconstructed

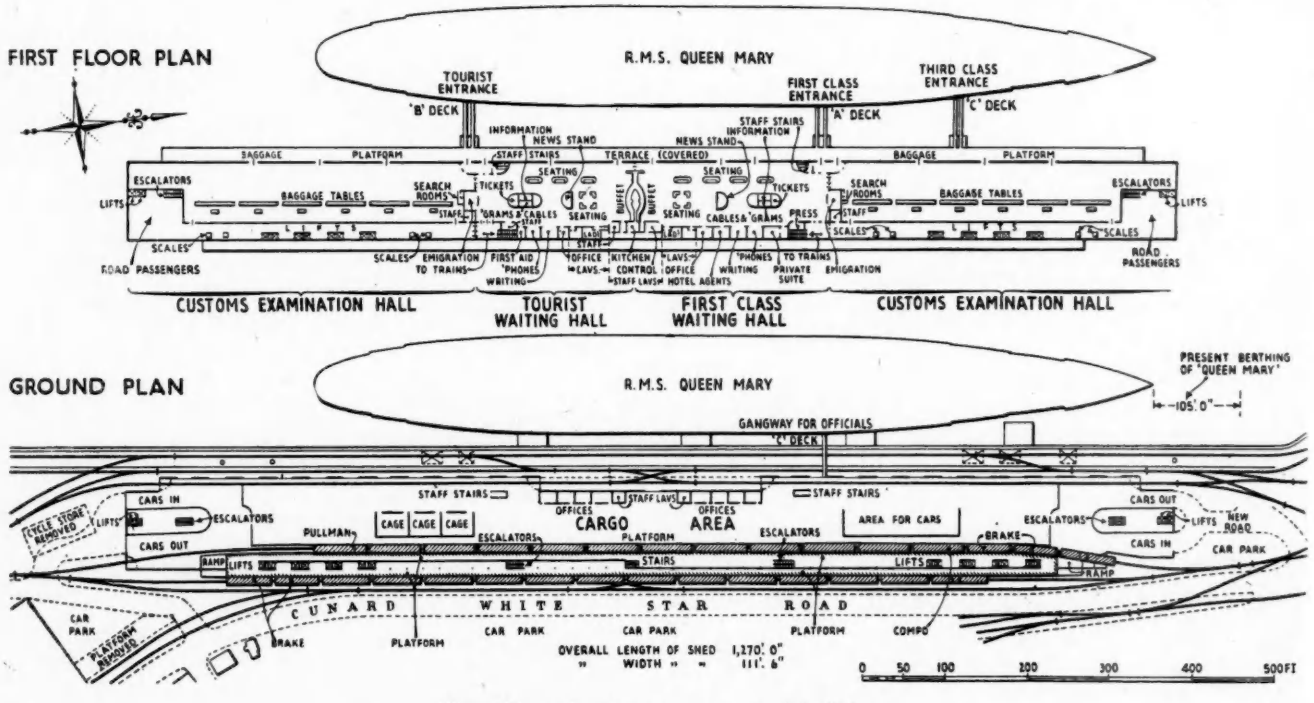
The Southern Railway Company have announced that they are undertaking a comprehensive scheme of equipping the Ocean Dock at Southampton with the most modern dockside buildings for handling ocean-going passengers and cargo. The estimated cost of the work is £475,000. It is hoped to be able to commence the work in the autumn of this year, and it is estimated that the scheme will take about twelve months to complete.

The proposed reconstruction involves building a new passenger and cargo station on the site of the existing transit sheds, which have been partly demolished by enemy action. The new building will be a radical departure from previous practice at the dock and will embody many features new to this type of structure. Primarily, it is intended for use by liners of the western ocean service, such as the *Queen Mary* and *Queen Elizabeth*, but it will also be available for other shipping when these two vessels are not in dock.

The existing single-storey war-damaged sheds will be demolished, and in their place will be constructed a two-storey building 1,270-ft. long, 120-ft. wide and 56-ft. high, which will embody all the latest devices conducive to the safety, comfort and convenience of passengers embarking or disembarking, and the speedy handling of their baggage. The proposed building will be able to deal with as many as 2,000 passengers arriving by one of the large liners, as well as cargo and motor cars. The outstanding feature of the scheme is that the new building will have two floors. The upper floor will be devoted to waiting halls and customs' examination halls. Passengers will leave or enter the liners on this floor. The waiting halls, of which there will be one each for cabin and tourist class passengers, will be 230-ft. long by 100-ft. wide. As soon as possible after the ship has docked, the passengers will proceed direct to their respective halls by specially-constructed gangways. Whilst their baggage is being brought ashore and assembled under the appropriate initial lettering in the customs' examination halls adjoining, the



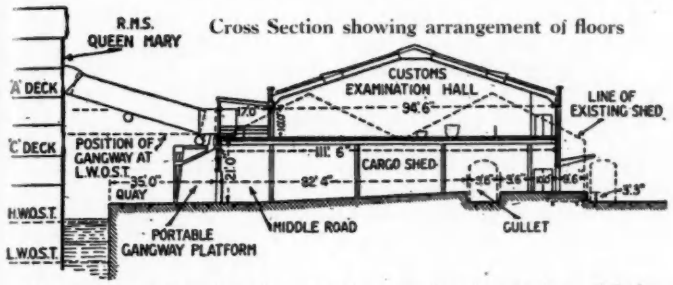
Map of dock system showing new passenger and cargo sheds shaded



Floor Plans showing arrangement of facilities

Southampton Docks Improvement Scheme—continued

passengers will be able to avail themselves of such facilities as telephone, cable and telegraph offices, refreshment buffets, news-teleprinter machines, money exchange offices, information and hotel reservation bureaux, newpaper stalls, tobacco kiosks, etc.



Cross Section showing arrangement of floors

Special attention is being devoted to the furnishing, lighting, heating and ventilating. The waiting halls will be equipped with a public-address system to relay messages to individual passengers and to make announcements relating to matters such as train and private car arrangements; they will also be equipped with well-appointed retiring rooms.

Dispersal of Passengers

After passing their baggage through the customs' examination halls, the passengers will proceed to the ground floor by means of escalators and electric lifts, and then into the trains or to road vehicles as required. Two railway tracks will be provided on the ground floor, separated by an island platform, so as to permit of two trains being dealt with simultaneously.

Special arrangements will be introduced for dealing with motor cars brought on the ship by passengers for their use while in Great Britain. After the usual formalities, the cars will be supplied with petrol and oil ready for the road. Passengers proceeding to their destination by cars sent to Southampton to await their arrival, will find every facility provided for their purpose.

A covered balcony will be provided for the use of persons meeting and seeing off passengers, and the roof of the building will be in the form of terraced balconies for the use of the many sightseers who visit Southampton Docks.

The scheme, when complete, will provide accommodation for passengers on the most modern lines, and on a scale unsurpassed anywhere in this country. The work is being designed by, and will be carried out under the supervision of, the Southern Railway Company's Docks Engineer at Southampton.

Impact Stresses on Jetties

By R. R. MINIKIN

The subject of the impact of moving vessels on jetties, wharves and the like is of peculiar interest at the present time. There is not only a large amount of repair work to be done to rehabilitate existing structures, but the reconstruction of some severely damaged; and fresh construction to meet new needs. In the endeavour to lay out economically the permitted expenditure, harbour engineers and their consultant colleagues are anxious to design their structures adequately for future needs, without capital expenditure upon what may be a doubtful contingency. It is in this latter category that the reaction to the impact of vessels may be placed.

The quantitative value of the full scale horizontal force imposed by the collision of a vessel with a jetty has never been definitely assessed, or perhaps it would be more exact to say, that there are no published records of any scientific measurement of the forces involved. Many engineers search in vain for enlightenment on the subject. This is not a new factor in the aftermath of war; indeed, Mr. C. P. Taylor, before designing the Northfleet jetty, some few years after the last war, mentions his anxiety in connection with his own pursuit of reliable information. He, on hearing of any damage due to the impact of vessels, immediately hurried to the scene to collect first-hand information in the endeavour to equate the resistance of the structure damaged and the force of the blow. The important point resulting from Mr. Taylor's investigations is that the design of the Northfleet jetty, which has been generally acknowledged to be a model of sturdiness and economy, was based, as far as the horizontal forces are concerned, upon the assumption that the quantitative value of the impact was due to a direct velocity of approach of one foot per second.

The paper in which Dr. Oscar Faber and Mr. C. P. Taylor described this jetty*, and the subsequent discussion, brought to light some interesting and instructive features. It would be helpful to quote those relevant to our problem.

" The design of the jetty was specially directed towards obtaining maximum lateral strength and stiffness in the concrete structure to resist the blows of ships."

" The horizontal force exerted on a jetty during the impact of a vessel is a matter on which no exact data exist."

" A jetty situated as this one is, probably has to withstand stresses due to the impact of ships that are higher than those due to the normal load, and special consideration was given to the question of the force of the blow which would govern the design."

The argument which followed shows that a vessel of 12,000 tons approaching the jetty at 1-ft. per second direct, was taken as producing the maximum blow on one fender pile. The kinetic energy of the vessel was assumed to be absorbed uniformly over a distance of 12-in. Again I quote: " The authors are of the opinion that the blow for which a jetty is designed varies less than does the size of the vessel, because the greater weight of a large vessel will be offset by corresponding greater care in handling her, and so the velocity of approach will be less."

In the discussion which followed, Mr. Wentworth Sheilds (President of Institution, 1944) cited cases of his experience at Southampton of the swaying of jetties due to the bumping received from ships and loaded barges. In this he was supported by Mr. Asa Binns, of the Port of London Authority, who pointed out that many of the P.L.A. jetties were built of timber in positions where they were most likely to be damaged by ships manœuvring. Mr. M. G. J. McHaffie contributed further to the discussion the pertinent fact that all vessels have their individual peculiarities when being manœuvred, whether large or small, and the danger to the jetty was in proportion to the experience of the pilot, of the ship and the port. Also, I quote, " because a ship was big and attended by tugs, it did not necessarily follow that she would give a slight blow."

The important point raised by Mr. McHaffie can be put in other words, thus; jetties do receive blows when vessels are berthing, whether tended by tugs or not, and the quantitative value of the blow depends upon how closely the navigator estimates the set of conditions of wind, tide, currents and ship's manœuvrability so as to reduce the vessel's direct velocity of approach. Mr. R. Stroyer, in his book, " Concrete Structures in Marine Work," gives the following figures as examples of design data:

A vessel of 2,800 T displacement with a velocity of 15-ft. per min.
" of 5,000 T " " " 12-ft. " "
" of 26,000 T " " " 25-ft. " "
at Wandsworth, Tower Bridge and Southampton respectively.

It will therefore be appreciated that before any stresses on the jetty can be computed the first necessity is to fix a reasonable value for the velocity of direct approach for the type, and displacement, of the vessels using the structure. The velocity fixed and the displacement known, we can then evaluate the kinetic energy of the vessel at the moment of contact. Since,

* Deep-water Jetty at Bevan's Cement Works, Northfleet. C. P. Taylor and Oscar Faber. Proc. Inst. Civil Engineers, Vol. 226, 1927-8.

Impact Stresses on Jetties—continued

to bring the vessel to rest, the kinetic energy must be absorbed by the jetty, the next step in our problem is to consider the manner of transference. To this end the author carried out a series of model experiments and found that the work done on the model jetty represented only a fraction of the kinetic energy of the vessel before contact. In fact, for timber models of ships and jetty this fraction had a value of 0.18 to 0.27†. In other words, there must be some other medium absorbing the dynamic energy of the moving vessel. It was concluded that water drag and swinging about the centre of buoyancy was responsible for this. Many colleagues who had experience of these matters agreed with this conclusion. Nevertheless it was felt that model experiments in quiet water could not reproduce the actual practical conditions, and only full scale and widely varying instances would give a definite solution.

In this connection it is instructive to note that Mr. Taylor's analysis of damaged structures resolved into an assumption of direct approach velocity only. A well known engineer, Mr. Ernest Latham, who has had a great deal of experience of damaged jetties, wharves, etc., in his book, "Marine Works," cites many instances of damage to structures from the impact of vessels, under, and out of, control; but, with one exception, does not give any figures showing the relation between the kinetic energy of the vessels and the strength of the structures damaged. Unfortunately for our purpose, the incident he details with calculations is that of a bridge pier run into by a barge of 100 tons displacement carried on a 2¾-knot current.

The great difficulty in equating, after the event, the applied force and the strength of the structure which is damaged, is that all the necessary factors are not known.

To examine a structure after damage and check back the strength of the individual members damaged cannot, with any confidence, be used as a guide to the force of a blow. It is difficult to tell whether the blow was received by one or several members simultaneously, or whether the damage was due to the initial blow only. There are times when a considerable amount of damage ensues after the blow has been delivered by the fouling of members in the subsequent swinging of the vessel.

But cases of this nature more generally come into the category of accidents above the average safety limits and it is not suggested that jetties be designed to meet these conditions. As a preliminary to the design of a jetty, apart from deck loads, it is necessary to fix the maximum displacement and draught of vessels likely to use it in its lifetime. Then it has to be decided what is the probable maximum adverse effect that the berthing of vessels will inflict on it. This, with almost complete agreement among engineers, is taken to be due to the blow of a vessel moving alongside whether under its own steam or assisted by tugs.

Now this blow can happen as a point or a broadside blow. As a point blow is the more serious, and probable, it is usually taken as the basis of the external impact forces to be resisted by the structure, and all transverse bents are designed accordingly. A broadside blow is distributed over the jetty for a length equal approximately to the length of the vessel, whereas a point blow is usually considered as distributed over a length of jetty equal to twice the breadth, which is but a fraction of the vessel's length.

The difficulty now arises to assess the amount of the lateral complement of the kinetic energy of the vessel, considering the line of the jetty as base: obviously the direct approaching velocity of the vessel is the main factor in doubt.

If we had reliable data of the average lateral approach velocities for vessels of various displacements the kinetic energy delivered in the blow could be computed; but there is yet another factor that comes into the problem. On the impact of two bodies, the initial kinetic energy of the system before impact is greater than the final energy after impact, that is there is a loss of kinetic energy in the blow, so that the effective work done in compression of the fenders and deflection of the jetty is less than the kinitic energy of the mass giving the blow. Again the usual method of coming alongside is at an angle to the line of the jetty so that a glancing blow is delivered by some point of the vessel distant from the centre of buoyancy. This causes the vessel to swing, in other words, the vessel is not brought to rest on first contact; hence the kinetic energy absorbed by the blow must be some fraction of the total kinetic energy of the mass.

Considering the factors involved, it is clear that the best way to solve the problem is by the collection of data of a wide range of normal berthing conditions, from which by scientific analysis, the relationships of the several factors may be assessed.

Now observations undertaken at one jetty, even if extending over a lengthy period, may perhaps be only applicable to but one set of conditions, whereas, if observations were made on a large number of jetties, under widely varying conditions and by different but interested observers, it is probable that a good average may be arrived at, when the sum of the results is analysed. On full scale measurement it will probably be found that quite a high percentage of the observations do not seem to produce very marked reactions. Nevertheless, if the complementary factors have been recorded, such observations are of as great a value as those producing more pronounced effects. Thus, if one feels the sway, as distinct from vibration, of a jetty 60-ft. away from the position where a blow is delivered, it is obvious that the stresses must be transmitted over a length of the jetty of at least 120-ft., providing the jetty has a uniform section. It is not necessary either to damage a jetty, or a ship, to find out the effective strength of a jetty against impact.

To solve the problem effectively, actual measurements of the berthing of vessels and the jetty reaction are required. In the endeavour to obtain an adequate number of actual berthing factors, the author, with the assistance of the "Dock and Harbour Authority," has requested a large number of Harbour Engineers and Managers for their assistance in the gathering of the necessary data. It is therefore hoped that within some months an authoritative and representative solution will be forthcoming.

† Design of Jetties, by R. R. Minikin, "The Structural Engineer," No. 8, Vol. XXI, 1943; and "Dock and Harbour Authority," October, 1943. "Dolphins," "Dock and Harbour Authority," January, 1945.

Chamber of Shipping

At a meeting of the Council of the Chamber of Shipping of the United Kingdom which was held in London early last month, the President, Mr. Joseph P. Maclay, referred to the increase in railway rates, and the submission to the Railway Rates Tribunal of the question of the best method of adjusting charges overall for next year. He pointed out that the Tribunal's enquiry, at which the Chamber will be represented, would be public and would cover dock and harbour dues at railway-owned ports, as well as charges for railway carriage. Wide considerations were involved of importance to shipping and trade in general. But they were glad to note the special provision in the terms of reference to the Tribunal that it must have regard to the "importance of maintaining adequate coastwise shipping services."

Regret was expressed that the Manchester pilots, for the first time in the history of Pilotage, chose to strike, rather than to rely on their constitutional rights under the pilotage Act. This, it was stated, was a serious development, giving cause for concern to the industry.

The President said that the Chamber would be represented at the meeting which the Ministry of Transport was holding to consider the proposals of the Manchester pilotage authority, and the pilots' claim.

On the question of the siting of new towns and the development of industries under the New Towns Bill and the Distribution of Industries Act, attention was drawn to the importance of transport facilities being provided, not only for passengers, but for goods traffic of both raw materials in bulk and manufactured articles.

It was agreed to point out to the Ministry of Transport that in addition to good road facilities, the parallel needs of other forms of transport should be considered, so that port and harbour services could play their proper part in the contemplated developments.

The Organisation and Control of European Inland Transport

*Need for Full Co-ordination**

Organisation and control of transport involves many interests and, perhaps more than in any other field of relations between the world's economic sections, a large measure of mutual agreement is required, necessitating joint efforts and common action. This is so in times of normal development; it is even more necessary in times such as the present, of rehabilitation, reconstruction in changed conditions and changed outlook on the future.

So much of the transport systems has been destroyed in the war years, especially in Europe, in the matter of physical assets as well as in operation and organisation, that there is now a golden opportunity to review and revise the organisation and control of transport in such a way that the best possible service is rendered to the maximum number of communities.

Europe's Inland Transport

Organisation and control of European transport must fit appropriately in a pattern for world-wide organisation. It must also fit in with other organisations in the economic and social field, most of which are of world-wide importance, some only of regional interest. It has particular features which gives it a special place in world transport generally, and this effects its control and organisation, which is different from that in other parts of the world.

In the first place, the inland transport system of Continental Europe is separated from that of Great Britain; and the Continental inland transport system itself is divided into two distinct parts. The Continent, from the Atlantic to the Russian border, forms one unit for inland transport; it has a unified standard gauge railway system, and a network of inland waterways, which in the near future will be completely inter-linked. The other unit is formed by Russia and some adjacent countries, with a broad gauge railway system and its own large waterways. The two parts have no little direct connection to allow through working without trans-shipment.

In the second place, the Continental system is relatively small in area, but it has a very dense traffic to handle, its difference from other similar units—say, the Continents of North America, of South America, of East Asia—shown principally in the fact that, though smaller in extent, its area embraces many nations with different modes of living, different languages, different economic and social demands. This has its bearing of course on the system of control and organisation required to make it an efficient servant of common needs.

In addition, this European inland transport system has its close relations with the United Kingdom across the North Sea and the English Channel, with Spain and Portugal across the break of railway gauge at the Pyrenees, also a natural barrier for through transport by road.

It has its junction with other areas, it has common problems to face, not only with the outside world, i.e., overseas shipping, air transport, also tele-communications which are world-wide, but also in its own limited area with short sea transport between U.K. and the Continent, surface transport, trans-shipment at the Spanish frontier and at the Russian border. It is not quite possible to organise European transport without taking into account these connections, e.g., certain vessels may use European inland waterways and proceed oversea to U.K. ports, or across the Black Sea to Russian inland waterways. certain special railway rolling stock is used in through services by ferry between the Continent and the U.K., other special rolling stock by axle-changing devices is used between the standard European railway system and the broad gauge Russian system. Road vehicles carry traffic into the Iberian Peninsula.

In the main body of European inland transport, these special inter-linking traffic problems are of relatively small importance, nevertheless they are far from negligible. The conclusion, therefore, is that control and organisation of European inland transport requires of necessity full co-ordination (a) with outside world transport, and (b) inside its own area, overlapping into immediate adjacent areas.

Railway Transport

The second world war brought the whole of the area we are considering to-day under one control, that of Germany and Hitler. The Germans did not unify the European railway system, they left the national systems in full administrative control, but they forced the use of all routes and equipment to serve one general purpose; the German military machine's requirements and Germany's economic needs. The final stages of the war completely upset these arrangements; the wholesale destruction and displacement of transport and equipment closed this period and left the new powers with a problem of almost complete reconstruction of transport in Europe.

What is the future of organisation and control of railways in Europe? It is already abundantly clear that return to normal conditions, particularly in international rail transport in Europe, will take many years, also that these normal conditions will materially differ from those of pre-war days. Close co-operation between governments and between administrations will be essential. Developments appear to point to the necessity of an expanded inter-governmental association on the one hand and the rehabilitation of the railway administration associations and their machinery for international co-ordination of rail traffic and technical operations on the other.

Roads and Road Transport

The war brought road traffic, internal as well as international, to an almost complete standstill as far as civilian traffic is concerned; but on the other hand, the military activities demanded international road traffic to an extent never before seen in Europe, first under German, and after the liberation, under allied military control.

Future development would point to a continuation of international governmental arrangements to regulate this long-distance road traffic in Europe. A good deal of work will have to be done to facilitate the movement across frontiers, and the supply of fuel, repair facilities, the feeding and housing of operators on an international basis. A continuation of the work of the Transit and Communications section of the League of Nations, the standardisation of road traffic signalling, and similar matters is urgently needed. As no inter-governmental association existed before the war, it may well be that the Regional Transport Organisation for European Inland Transport will usefully operate in road transport as it is envisaged to do for rail, and, most likely for water transport.

Inland Water Transport

In this branch of inland transport we find an example of common organisation and control with other economic and social public interests; inland water transport uses routes which also serve purposes of drainage, irrigation, hydro-electric power, etc. Inland waterways are, therefore, under government control, national as well as international.

By a decision of the Congress of Vienna in 1815, certain navigable rivers in Europe with a natural outlet to the sea were declared international. They are the rivers Rhine, Danube, Elbe and Oder. Though the actual waterways are under State Control, the operation of the vessels using these waterways is left entirely to private enterprise. The basic principles of inland transport of these waterways are freedom of navigation to all, and equality of all flags.

Inland waterways and railways together have carried practically all Europe's inland transport. The importance of inland waterways may be shown by a few figures: 200 million tons of freight were carried per annum in pre-war years—one-fifth of all inland transport. The total tonnage of inland shipping exceeds the combined tonnage of ocean shipping of the Continental European States. The difference in control and organisation between rail and water is guided by the difference in administration and operation. On railways, routes and vehicles are under the same administration and operation, and in all Europe there are not more than 20 such administrations. On waterways, the route is under government administration, the vessels are operated by

* Excerpts from a Lecture recently delivered at the London School of Economics by Professor E. R. HONDELINK, Director-General of the European Central Inland Transport Organisation.

Control of European Inland Transport—continued

a multitude of individual owners, small and large companies, and the supply of motive power is a divided operation; where motive power is separately supplied, i.e., by tugs, the operation is in different hands from that of the carrier vessels.

There is yet one other main difference between inland water transport and rail transport. In the latter, the state authorities have imposed on the operating bodies the " obligation to carry "; this compulsion did not exist for inland water transport.

Before the war, a beginning was made in Nazi Germany with compulsory grouping of German inland water transport. Thereby, means of competition were introduced, and a number of other European states were induced to adopt preference legislation for carrying out import and export in national shipping.

In the war, the Germans introduced further measures of control, " obligation to carry " was introduced, and requisitioning of inland craft, sometimes with the crews, sometimes without, brought about some measure of unification used principally for the purpose of relieving rail transport.

In the present transition period, joint control and organisation is being retained. For example on the Rhine, the pre-war international Central Rhine Commission in control of the river, has been re-established, but freedom of navigation and equality of all flags has not been restored. Shortage of equipment, the necessity to assure priorities for essential traffic, the need for co-ordination of rail, road and water transport in carrying traffic of common concern, have necessitated the establishment of a separate Interim Working Organisation on the Rhine. First military in its set-up, it is now international in character, and all riparian governments, the Occupation Authorities in Germany, the Central Rhine Commission and the European Transport Organisation are represented on the organisation. Its main purpose is the allocation of traffic, and the ensuring of appropriate grades of priority.

On the Danube, Elbe and Oder, both the rivers themselves, and the traffic they carry, are at present still under the control of military and occupation forces.

The future may have to take account of the fact that Europe's inland waterways were becoming more and more inter-linked by the construction of connecting canals. Co-ordination between the four systems may well be a task for future organisation by a European regional transport body.

Ports

Ports are the links between inland transport and sea transport; in some cases they also serve as junctions in inland transport. Coastal shipping, usually not considered to fall under inland transport, also demands a connection.

All European ports are controlled by some local official body, sometimes the State or the Municipality, sometimes a Public Corporation, sometimes a combination of any two of these.

Before the war, there was no co-ordination of traffic between ports; each port was free to attract its trade. However, government transport authorities and railway administrations, together with port authorities, attempted to gain trade for particular ports by competitive rail and waterway tariffs.

During the war, port control and administration was brought under military control, first under German, then, after the liberation, under the allied military command. The allied military control had to cope with considerable damage, and with heavy concentrated traffic, storage, and clearance problems. These difficulties were overcome in a short time, so that ports did not remain for long a bottle-neck in the junction between ocean and inland transport.

At present, in the transition period, ports are again under their original control But for the first time in their existence, the routing of traffic to ports is laid down, not on account of their handling capacity, but because of their clearance capacity by inland lines of communication. This necessitates common organisation, and the European Central Inland Transport Organisation, together with the Overseas Shipping Authorities and the National Authorities, are the co-ordinating organisations to ensure the working of traffic without interruption.

Already problems of routing from overseas and clearing on inland transport to Hinterlands served by more than one port present themselves. Again mutual understanding is required to effect common action, most likely best served by a Regional European Transport Organisation

Co-ordination

Before the war, co-ordination between the different branches of inland transport was carried out on a national basis only, each government planning and acting in its own sphere. Internationally only the League of Nations' Communication Section served the member governments in some way, by collecting information and distributing it as material for further study.

International co-ordination for military purposes was active during the war. At present, as a transition measure, it is in operation for the movement of traffic of common concern under the direction of the European Central Inland Transport Organisation, covering rail, water and road transport.

One serious difficulty here is the problem of transport charges in transit as long as currency transfer, clearing, and rate of exchange problems remain unsolved.

For the future, it appears likely that co-ordination in the international field may be assured by common agreement under a European regional governmental transport body. In normal times, some fundamental facts must be considered in order to arrive at a sound form of co-ordination. Not only transport as such is involved. Transport is a factor in all fields of industrial, technical, economic and social developments. Compulsory allocation of the traffic between different branches may interfere with industrial and commercial development, if the cost of transport is not well balanced, or if the allocating authority does not bear the whole cost, or at least the difference.

The characteristics of the various branches of transport, such as speed, carrying capacity, flexibility of routing, costs, charges and many other factors always considered in internal co-ordination planning are well known. In international co-ordination, additional factors enter at the crossing of frontiers, such for example as the passage of vehicles and vessels, passage of crews, maintenance and repair facilities away from the home country, equipment and supply, which in turn, effects such factors as speed in transit, loading capacity, etc.

In this field I foresee a long-term activity by individual and common organisations, but always working closely together for the common good.

Port of Fremantle, Western Australia

By OUR AUSTRALIAN CORRESPONDENT

The Western Australian Government has engaged for two years the services of Col. F. W. E. Tydeman, C.I.E., B.Sc. (Eng.), M.Inst.C.E., M.I.Mech.E., M.I.Struct.E., to carry out an investigation regarding the progressive and planned development of Fremantle Harbour, and to advise the Government thereon. The Government is anxious that the investigation should be as wide as possible, not only providing for the needs of the next 10 or 20 years, but over a longe range period. Col. Tydeman, who was chief civil engineer to Singapore Harbour Board up to the fall of that city, will, in addition to reporting on the development of the harbour itself, report upon the location and construction of a dock, investigate the equipment, storages, sidings, etc., at the existing wharves and submit recommendations as to new buildings and equipment, which would increase cargo-handling capacity. He will collaborate with officers of the Fremantle Harbour Trust, the Commissioner of Railways, and the Commissioner of Main Roads so that road and rail proposals may be co-ordinated with the harbour development scheme, and will also examine and advise on any alternative proposals for the development of the harbour which the Government may put forward. If requested, he will advise the Government on matters affecting the development, maintenance or equipment of other ports or harbours in the State.

At the moment dredges and equipment are lying idle in Fremantle, and little maintenance work is being done despite the fact that shipping is very heavy. Both shortages of material and man-power are at the moment the cause of considerable concern.

The Structural Engineering Co., of W. A., Ltd., recently completed the building of an 80-ton floating crane for the Fremantle Harbour Board.

Reinforced Concrete Caissons for Marine Works

An Article for Students and Junior Engineers

By STANLEY C. BAILEY, Assoc.M.Inst.C.E., F.G.S.

(Concluded from page 49)

Caisson for Training Wall

In Figs. 8 and 9 a cross section and plan are shown of a caisson 67-ft. by 18-ft. by 32-ft. high, suitable for a river training wall, having triangular ends for easy towing purposes, and for bonding with other sections, as shown by Fig. 10, in which the portions on a curve are formed of caissons with semi-circular ends. The floating-out weight will be 525 tons = 66.5 lbs. per cub. ft. external volume, and the draught will be 17-ft.

The total weight when filled with sand and gravel and an 18-in. thick concrete deck will be about 1,938 tons, less the upward water pressure of 796 tons for 26-ft. depth = 1,142 tons or 1.06 tons per sq. ft. on the river bed.

The sides of the wall should be protected by rubble stone mounds, or concrete in bags, as a protection against scour.

The weight of the sand and gravel filling against each side is 9.5 tons per lin. ft. and the horizontal pressure = 5.5 tons, which is equivalent to 24 lbs. cub. ft. fluid pressure, and 0.36 tons per sq. ft. at the bases of the side walls, and as the water pressure is 0.74 tons sq. ft. there will be an excess water pressure of 0.38 ton per sq. ft.

If the tension steel rods in the side walls are of the same diameter throughout the height, to obtain the spacing of them for equal areas of pressure, construct the equilateral triangle A, B, C in Fig. 8 and divide the hypotenuse A.C. into 26 equal parts, corresponding to the 26-ft. depth. Erect a semi-circle on the hypotenuse, and vertical lines from the equal spaces on that line to the circumference; from A draw arcs of circles from the points on the circumference to the hypotenuse, and where these cut the latter, draw lines parallel to the base B.C these lines will divide the triangle A, B, C into equal areas of pressure per ft. depth, and will give the spacing of the steel rods. For convenience B.C. may be divided into a scale of 0.38 ton per sq. ft., the effective pressure on the wall at the base shown in the diagram; at and for several feet below the water level the wider spacing may cause tension in the concrete, so additional rods will be required here.

Caisson for Dolphin Mooring

Fig. 11 illustrates a caisson 24-ft. by 24-ft. by 44-ft. high in cross section and plan to be used as a dolphin for mooring ships to; this will weigh about 543 tons = 47.9 lbs. per cub. ft. outside volume, its floating-out draught will be 33-ft. with 11-ft. freeboard. The weight when sunk and filled with concrete, including the cast steel bollard and timber fenders is 1,665 tons, less the upward water pressure of 625 tons for 38-ft. depth of water = 1,040 tons or a normal load of 1.8 tons per sq. ft. on the sea bed.

The concrete ballast required to sink the caisson = 625 − 543 = 82 tons equivalent to 3.28-ft. thickness of concrete.

The dolphin should be surrounded at the base with mass concrete or concrete bagwork, to protect it from scour, and the holes excavated by ships' propellers.

Assuming that a ship 440-ft. by 58-ft. by 32-ft. moulded depth is lying alongside two dolphins spaced 400-ft. apart, and that the loaded draught is 25-ft. and light draught 14-ft. with 18-ft. freeboard. Under light draught, the area exposed to a side wind in a gale at 30 lbs. per sq. ft. pressure is 7,920 sq. ft. plus 780 sq. ft. for the superstructure = 8,700 by 30 lbs. = 116.5 tons or 58.25 tons per dolphin. If there is a tidal current of 2.5 knots per hour (4.22 ft. per second) flowing in the same direction as the wind; the water pressure in lbs. per sq. ft. = $P = 1.184\ V^2 = 1.184 \times 4.22^2 = 21$ lbs. sq. ft. and 440-ft. × 14-ft. × 21 lbs. = 57.7 tons, or 28.8 tons per dolphin, the total from the wind and water will therefore be 87.05 tons. If there is a pull on the hawsers, two of 6-in. girth will be necessary at each dolphin, the breaking weight of one being about 113 tons, the pull of 87 tons will produce the resultant R2 and a pressure at the base of 3.45 tons per sq. ft. on the side nearest the ship, and a pressure of 0.5 ton per sq. ft. on the opposite side; while a push of 87 tons at the water level will cause R1 to fall 8-ft. from the outer toe of the dolphin and result in a pressure of 4 tons per sq. ft., in which case the sea bed must be composed of a hard stratum, if not, a hole about 30-ft. square and 4-ft. deep will require to be excavated by a grab dredger, and filled with concrete, on which to bed the dolphin. On account of the 33-ft. draught of the caisson, it would be advisable to construct it in either a dry dock or floating dock.

Types of Caissons

Figs. 12 to 22 are sketches of cross sections of various types of reinforced concrete caissons that have been constructed at seaports for wharf walls and piers; those at Aalborg in Denmark (Fig. 12) were about 100-ft. by 10-ft. by 28-ft. high with a 20-ft. wide base, and were filled with concrete, they were constructed on a slipway, tilted over, and launched lying down on the face with the heel upwards, the tops being temporarily closed with timber planking.

At Kobe (Japan), Fig. 13, the caissons were about 117-ft. long, 24-ft. wide at the top, increasing to 30-ft. at the base, and heights of 35-ft. 6-in. to 41-ft. 6-in. There were nine bulkheads and a central one dividing each caisson into 20 cells, and they were built and launched from a depositing dock.

In the Port of Gdynia, Poland, the caissons (Fig. 4) were 105-ft. 9-in. by 32-ft. 9-in. by 50-ft. high, there were nine cells in the length, and the weight of each caisson was about 1,200 tons. At one end of each caisson there were four vertical projections or nibs, and at the opposite end there were two, for locking them together; the caissons were launched while lying on one side by tug boats pulling on their bases, a portion of the tops having been closed by boarding, and when afloat, water ballast was pumped in from a ship lying close alongside.

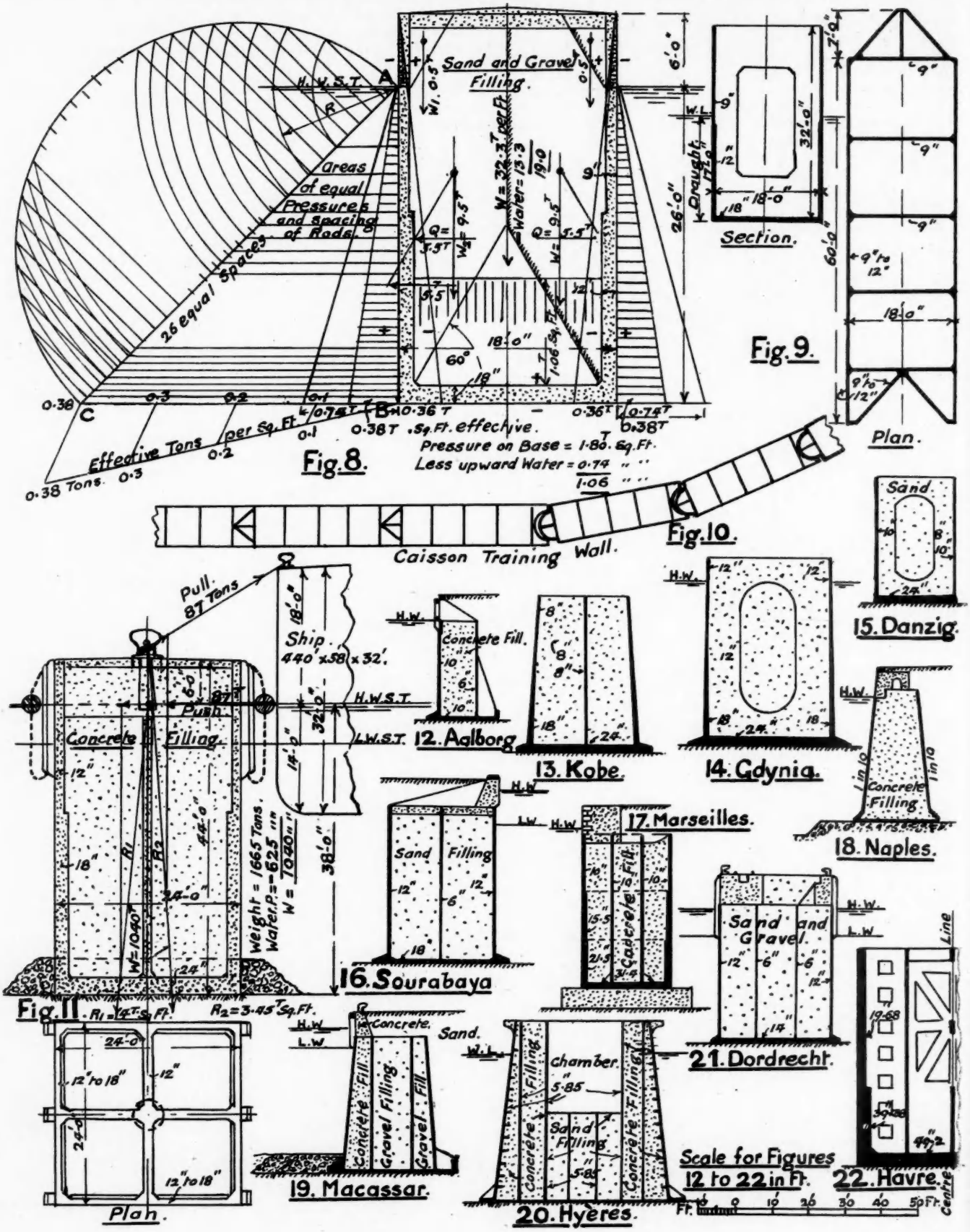
The Caissons at Danzig (W. Prussia), Fig. 15, were used for wharf walls and piers and were 59-ft. 9-in. by 21-ft. 7-in. by 34-ft. 6-in. high, the length of each being divided into five cells. When sunk in situ the outer walls 10-in. thick were increased to 4-ft. with concrete, and the interiors were filled with sand. They were built on a slipway, tipped into the water, the sand bottom being dredged away until they floated, when they were towed to the site, and sunk, with a 3-ft. 6-in. space between them, which was afterwards filled with concrete between shuttering.

At Sourabaya, Belawan and Semerang in Java, the Dutch have constructed wharf walls formed of reinforced concrete caissons (Fig. 16), about 27-ft. 3-in. to 29-ft. 6-in. wide and 42-ft. high, with longitudinal and cross bulkheads, the caissons being filled with sand.

In the Port of Marseilles, some of the wharf walls are formed of caissons (Fig. 17) about 98-ft. 5-in. by 24-ft. 7-in. by 41-ft. 4-in. high, these have 36 cells, and were towed to the site, and sunk on a level bed of concrete from 3 to 6-ft. thick, by admitting water through valves in the bottom, these were then closed, the caissons were weighted, the water pumped out, and the interiors filled with concrete.

Caissons (Fig. 18) used at the Port of Naples for wharf walls were 13-ft. 1-in wide at the top and 20-ft. at the base with a batter of 1 in 10, the bases were further increased to 24-ft. 7-in. by a toe on each side. and their height was 34-ft. 9-in., the interiors being filled with concrete.

Reinforced Concrete Caissons for Marine Works—continued



Reinforced Concrete Caissons for Marine Works
(continued)

In the Celebes at the Port of Macassar, the Juliana Quay was formed of caissons (Fig. 19), 81-ft. 2-in. by 18-ft. 6-in. wide at the top increasing to 25-ft. at the base, which was further widened by a toe on each side to 34-ft. 6-in., the height being 37-ft. There were two longitudinal bulkheads, the section on the water side was filled with concrete, and the other two with sand. About 1911 in the Bay of Léoube, near Hyères, the French constructed a torpedo-firing range, the firing station was formed of a reinforced concrete caisson on the Hennebique system, this caisson (Fig. 20) was 68-ft. 10-in. by 36-ft. 4-in. at the top and 77-ft. by 48-ft. 6-in. at the base by 49-ft. 2-in. high, it weighed about 2,558.5 tons and drew 26-ft. 3-in. of water.

It was partially constructed in a dry dock at La Seyne, floated out and completed in the harbour, being towed to the site 25 miles distant in 15 hours by a wire rope passed round the caisson.

It was divided into 77 compartments by vertical concrete bulkheads, and was sunk at the site by pumping water into it from the pumps of a tug boat, on to a prepared rubble stone mound about 12-ft. thick, which rested on rock, and the base was surrounded with blocks of stone. Concrete was deposited in the two outer rows of cells, the others being filled with sand. In the sketch section, Fig. 20, the superstructure erected on the caisson has been omitted.

In Holland at the Port of Dordrecht a pier 918-ft. long has been constructed of seven caissons (Fig. 21), each 130-ft. 10-in. by 31-ft. by 37-ft. 8-in. high, they were filled with sand and gravel.

Fig. 22 is a half cross section of a heavy type of caisson used at the Port of Havre, it was 101-ft. 8-in. by 52-ft. 6-in. by 59-ft. high, and was divided into cells by longitudinal and cross bulkheads of concrete, the bulkheads having openings in them as shown in the sketch, to reduce the weight. Reinforced concrete caissons for breakwaters and wharf walls have also been used at Algoma (Lake Huron, Canada), at Bizerta (Tunis), at Chefoo (China), and at Alexandria (Egypt), those at the latter port were constructed on a slipway and launched by pulling them into the water by means of tug boats.

National Harbours Board of Canada

Excerpts from the Tenth Annual Report

Shipping

Vessel arrivals in 1945 numbered 38,467, the aggregate net registered tonnage being 29,046,089. In 1944, the comparable figures were 38,042 vessels, aggregating 27,019,836 net tons.

Cargo Tonnage

In 1945, the aggregate volume of water-borne cargo, inward and outward, was greater than in the previous year by 4,816,923 tons, or 19 per cent. The figures were 30,082,947 tons in 1945, as compared with 25,266,024 tons in 1944. The increase was almost entirely due to the greater quantity of grain shipped.

The movement of goods outward, for destinations abroad, was the greatest in the records of the Board. Inward cargo from abroad showed a small increase over the previous year but was only 60 per cent. of the import tonnage in 1938.

Domestic traffic showed an upward trend but it also was appreciably lower than prior to the war.

Revenues and Expenditures

Operating revenues of all units administered by the Board amounted to $13,395,824, as compared with $12,538,318 in 1944. The increase was $857,506, or 7 per cent. Substantially higher revenues were obtained from the operation of wharves and piers and grain elevators. The earnings of other facilities, such as terminal railways, cold storage warehouses, sheds and equipment were lower than in the preceding year.

Expenses of administration, operation and maintenance in 1945 were $6,851,249, as against $5,999,089 in 1944, showing an increase of $852,160, or 14 per cent. Operating expenses of grain elevators accounted for more than one-half of this increase, shipments of grain being, in the aggregate, over 109,000,000 bushels in excess of the quantity handled in 1944. Maintenance expenses of all facilities were $327,000 higher than in 1944. During the past year, wages of employees were revised, effective July 1st, 1944, in accordance with governmental direction. The accounts for 1945 reflect the upward adjustment over the whole year and, in addition, include approximately $100,000 for retroactive payments in respect of the latter half of 1944.

As the increase in current expenses absorbed almost the entire increase in operating revenues, the operating income varied only slightly from that shown in the previous year, being $6,544,575 as against $6,539,229 in 1944.

After taking into account debits and credits to income, and charging interest and reserve for replacements, the operations for 1945 resulted in a net income deficit of $3,088,650. The corresponding figure for 1944 was $3,097,623. The net improvement over 1944 was, therefore, $8,973.

The operations of the board fall into two divisions: first, the seven harbours administered by local commissioners prior to 1936, and secondly, the grain elevators at Prescott and Port Colborne and the harbour of Churchill which were entrusted to the Board for operation at the beginning of 1937. Consolidated income statements for each of these divisions are set out below.

The seven harbours referred to—Halifax, Saint John, Chicoutimi, Quebec, Three Rivers, Montreal and Vancouver—had aggregate operating revenues in 1945 of $12,840,538, as compared with $11,969,838 in 1944. The increase was $870,700, or 7 per cent. Expenses of administration, operation and maintenance increased from $5,662,772 in 1944 to $6,433,449 in 1945, the difference being $770,677, or 14 per cent. Operating income rose from $6,307,066 in 1944 to $6,407,089 in 1945.

After taking into account income debits and credits and charging interest and reserve for replacements, a net income deficit of $3,235,047 was shown for these harbours in 1945. The corresponding figure for 1944 was $3,329,084. The improvement was, therefore, $94,037.

Consolidated income statement for the grain elevators at Prescott and Port Colborne and the harbour of Churchill showed operating revenues of $555,285 in 1945, as compared with $568,481 in 1944. Operating and maintenance expenses were $417,799, as against $336,317 in the previous year. The surplus of revenues over expenditures was $146,397, as compared with $231,461, a decrease of $85,064. The quantity of grain handled at Prescott and Port Colborne was much greater than in 1944, with consequent increased operating cost. Earnings from storage were sharply reduced. These changes affected net earnings of these facilities adversely. Due to increased operating and maintenance costs, the harbour of Churchill showed a somewhat greater loss than in 1944. The accounts for these facilities do not include charges for interest or reserve for replacements, other than a small amount for interest on capital expended since these units were transferred to the Board.

Capital Expenditures

Capital expenditures during 1945 amounted to $245,202. An additional sum of $21,151, charged to reserves, was expended on replacement of physical assets, the total outlay being $266,353.

The book value of fixed assets as at December 31st, 1945, was $224,762,142.

Finance

In addition to the sum of $245,202 shown above as being required for capital expenditures, the following additional amounts were obtained from the Dominion Treasury; an advance of $558,125 to cover cash deficit resulting from the operations of Jacques Cartier Bridge, Montreal; and a payment of $85,859 representing the loss on the operation of the harbour of Churchill. The total financial assistance in respect of the year's operations was $889,186.

On the other hand, payments by the Board to the Dominion Treasury during 1945 totalled $4,611,023, made up as follows: interest on advances, $4,200,000; earning of Port Colborne elevator, $142,740, and of Prescott elevator, $147,988 (being for the year 1944); and refund of advances for capital expenditures in previous years $120,295.

An advance for working capital, under Section 28 of the National Harbours Board Act, in the amount of $30,000, was required for Churchill Harbour during the year.

Legal Notes

The Law relating to the Pollution of Rivers and Streams*

By G. E. WALKER, M.A., LL.B. (Cantab), M.Inst.S.P.
(Secretary and Solicitor, Conservators of River Thames).

(Concluded from page 52)

DISCUSSION

The President said the Author had given in a most compact and understandable form, a valuable résumé of the law relating to this matter. It would be agreed that the volume of legislation was strikingly large but when we looked at the poor condition of the water in some of our rivers and streams it was quite obvious that there was something wrong. The paper was, perhaps, a little off the usual line of papers read before the Institution, but it was an excellent principle that engineers should know something about the law relating to the subject with which they dealt.

Continuing, the President referred to one or two matters arising out of the paper. With regard to the fact that sewage effluent did not apparently always reach the Royal Commission's standard, he said that supposing a local authority were to call the Conservators' bluff when they were told that one of the decimal points was in the wrong place, what would happen? Would the Thames Conservancy have to prove that definite pollution of the river had taken place? Moreover, over what area would it be necessary for the pollution to take place and how could the pollution be proved? He had often wondered about that. Then there was another point. " Pollution " was rather a vague term because while there were prescribed limits of pollution in a chemical sense, what about bacterial pollution? He raised this point because there was now a suspicion that infantile paralysis could be spread by sewage. He did not know how much truth there was in that but obviously it might be a very serious thing.

Finally, there was the question of dilution. Sometimes a sewage effluent went into a brook in which there was practically no water in dry weather; obviously the discharge of that brook was practically all sewage effluent. On the other hand, a sewage effluent might be discharged into a fast flowing stream of substantial volume so that the dilution was bound to be great. It was difficult to see how that point could be catered for by law. Perhaps the Author would indicate whether it was the practice to take these points into consideration when dealing with effluent analyses.

The Author said that as regards a particular effluent, under the Thames Conservancy Act, it would have to be proved that the effluent was sewage or offensive or injurious. The Conservators would be the prosecutors and it would be for the Bench of Magistrates concerned to say whether a particular effluent was offensive or injurious and that, of course, was a matter of evidence.

As to pollution, the Act under which the Thames Conservancy worked contained no standard on that matter. Obviously, the Bench would have to hear evidence on that and it would be relevant for them to consider whether there were likely to be serious consequences from what had been done when considering the actual offence. If anyone polluted a stream in the Thames Catchment Area, they were liable to be proceeded against by the Thames Conservancy but, for example, if a tea cup full of sewage were put into the Thames at Teddington it would not be so harmful as a thousand gallons in another place and so on. However, in both cases an offence might have been committed.

Mr. A. Sciver, B.Sc., F.I.C. (Fellow), asked the Author's view with regard to the sort of case that often happened, where there was no positive pollution in the sense of something being added to the stream, but where something was being abstracted from the stream, viz., dissolved oxygen. There were a number of cases, such as factories using large quantities of water for cooling purposes, in which nothing injurious was added to the stream but where the dissolved oxygen was seriously removed with all the usual adverse effects on the life of fish and the development of fungoid growth in the stream. How would the Author interpret the ramifications of the various Acts regarding the removal of dissolved oxygen

With regard to the bacteriological examination of polluted waters, nearly all prosecutions had been undertaken on the basis of chemical evidence of pollution but, although bateriological pollution could be very serious at times, very little was done about it. It was nearly always possible to prove pollution of a bacteriological nature by a sewage effluent no matter how satisfactory it was as regards chemical standards and the speaker had often employed bacteriological methods as confirmatory evidence over and above the chemical methods.

The Author replied that where a prosecution was taken under a Statute it was for the Court hearing the case to decide on the evidence whether there had been a breach of the law or not. As regards the removal of dissolved oxygen and whether the result was injurious to the water, as far as the Thames Conservancy was concerned that would have to be interpreted by the Tribunal. So far there had not been such a case before the Courts in the Thames Conservancy Area and personally, he would not like to suggest that the Tribunal would find. It would be a matter of evidence, and no doubt there would be expert witnesses on both sides. Therefore, he would not express any views on that point.

As regards bacteriological examination, that again could be part of the evidence. The Thames Conservancy Act did not prescribe a bacteriological or any other standard and therefore in any prosecution it would be necessary to consider all relevant matters. The Conservators did not as a rule make bacteriological tests, except only in special circumstances, and he did not think it was the usual practical of any other river pollution authority to do so in every case.

Col. E. F. W. Mackenzie, O.B.E., M.C., M.B. (Hon. Fellow), said that under the definition of pollution set out in the paper, bacteria pollution would have to be considered, but he understood there were no standards of bacteria pollution at present. It was not his intention to advocate on this occasion that there should be such standards, because it was neither the time nor the place. It was an easy thing to say that water should be rendered bacteriologically pure, but if that were done it might upset the whole growth of the flora in the stream and the natural processes of purification.

The Author had stated that the right to pollute a stream could not be acquired if such pollution would result in injury to public health. That word " would " seemed to him to be the most important word in the paper. It was very difficult to say whether any pollution *would* result in injury. It depended on whether anybody drank the water. No doubt some of those present would recall an epidemic of paratyphoid—he would not mention the name of the place—which led to the pollution of a stream by paratyphoid bacteria. He believed there had been a second epidemic in the same town. This was said to be due to cows grazing in infected pastures with subsequent contamination of the milk. That was the reputed history of the case. Would the law have considered that the pollution *would* have resulted in injury to the public health? That seemed to be a very important point in this matter.

As regards the spread of infantile paralysis, mentioned by the President, he did not know whether this was the place or the time to speak about this, but he had been investigating the whole problem—and it was a very important one. The virus could live in sewage effluent or water for as long as 100 days. It was not destroyed by chlorination in the concentrations normally used in waterworks practice and, therefore, there was unquestionably a possibility of infantile paralysis being carried by water. He had been in correspondence with one of the leading epidemiologists in this country and they had agreed there had not been an epidemic of infantile paralysis which had been proved to be due to a water supply. It was to be hoped there would not be one. Even so, this did not mean there never had been an epidemic due to infected water because infantile paralysis was a disease which did not afflict many people and therefore the " scatter " of the cases in an epidemic was indefinite. There were not many cases and the character of the epidemic might be confused by that. There

* Excerpts from a Paper read at a Sessional Meeting of the Institution of Sanitary Engineers.

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might have been water-borne epidemics which had not the appearance of such, but it was a very difficult thing to prove whether it was due to the water or not. Work in Sweden quite recently, but not yet published in this country, had shown conclusively that the discharge from hospitals where cases were being treated infected the sewage, and there was evidence that the virus multiplied very rapidly in the sewage. Although there might be only a small amount if virus going into the sewage, there might be a very large amount of infection in it after a few days or a few weeks.

The Author said the main point raised by Colonel Mackenzie was a question of distinguishing between the common law position and the statutory position. Under the common law he believed a bacteriological test would be relevant. In this connection he quoted the case of Young and Bastin *versus* the Godstone Rural District Council. However, he knew of no case in which a conviction had been obtained under a Water Pollution Statute on purely bacteriological evidence.

As stated in the paper, there could be no prescriptive right under the Common Law to pollute a water course so as to be injurious to public health—see Blackburn *versus* Somers.

Mr. A. E. Rawson, M.Sc., F.I.C. (Chief Chemist, Colne Valley Water Company), said that, although he could claim no great knowledge of matters relating to the law, he was intensely interested in the purity of drinking water supplies and the quality of effluents.

At the end of the paper, he noted that some details were given relating to the quality of effluents and it was interesting to observe the standards which were insisted upon by the analyst of the Thames Conservancy. It was significant that the standards laid down in the Hertfordshire County Council (Colne Valley Sewerage, etc.) Act, 1937, and in the new Middlesex County Council Bill relating to the West Middlesex and East Middlesex Sewerage District were similar. It appeared that many of the standards had come into operation in recent years and in his opinion the defining of specific standards constituted an advance Amongst other things, it helped those in control by showing clearly what they must achieve. He asked if, in the view of the Author, this practice was likely to be more generally adopted.

In his opening remarks, when discussing the question of purity, the President had referred to the subject of decimal points. This raised a matter which was not unimportant. In the paper, it was stated that the analyst of the Thames Conservancy regarded an effluent as offensive or injurious if the suspended matter exceeded 3.0 parts per 100,000 and the dissolved oxygen absorbed in five days exceeded 2.0 parts per 100,000. On the other hand, Parliament decided in the Hertfordshire County Council Act, 1937, that the discharge or effluent to the River Colne should not contain more than 3 parts per 100,000 of suspended matter and that it should not take up more than 2 parts per 100,000 of dissolved oxygen in five days at 65° F. He enquired if this discrepancy in the figures indicated that the analyst of the Thames Conservancy was more stringent than Parliament regarding the quality of effluents.

Although a considerable amount of attention had been directed towards the definition of pollution, it was doubtful if the same amount of thought had been devoted towards its assessment and measurement. Emphasis was frequently laid on the chemical aspects but questions of a bacteriological and even biological character were bound to arise from time to time when reaching decisions.

When assessing pollution, the accuracy of the results was of prime importance. It was, however, well known that experienced and competent analysts sometimes obtained different results even with duplicate samples of an effluent. This did not necessarily reflect on the skill of the analysts but it was often due to slight differences of technique. As far as possible in work of this character, the personal element should be eliminated. He, therefore, submitted that standard methods should be laid down in connection with the examinations of effluents, waters, etc., and that it should be obligatory on the part of those concerned to follow these methods. This he considered to be particularly important in those cases involving prosecutions. As technique and accuracy improved the methods could be revised. He wondered if the Author agreed with this suggestion. As an illustration of what he had in mind, he referred to the clause in the Herefordshire County Council Act, 1937, dealing with the incubator test for putrescibility for here the personal element seemed to enter to a marked degree. Since various people differed widely in their capacities to detect odours he asked the Author who would decide: (*a*) if the incubated effluent had, in fact, an odour and if it had (*b*) whether the odour could be considered to be offensive. As laid down, the test might give rise to considerable differences of opinion.

Although some progress had been made in this country on the standardisation of methods, very little had been achieved in the realm of water and sewage. On the other hand, as was obvious from the publications, the matter had received considerable attention from the American Public Health Association. He felt that, as soon as conditions permitted, the example should be followed by those in authority here.

The Author said he owed the meeting an apology because the two standards referred to by Mr. Rawson were supposed to be exactly the same. This was the disadvantage of copying one from an Act of Parliament and another from an analyst's report. As to whether or not Parliament was likely to adopt a standard, he personally wished they would, but he feared it would be a long time possibly before this happened. Similarly, it would be very desirable to have laid down by the legislative a standard system for analysing samples. Most persons concerned were anxious to comply with the law and if a certain method could be agreed upon, it would be a great advantage, but all this took time to bring about. A standard with regard to quality would also help very much.

The analyst of the Thames Conservancy had been engaged on this work for fifty years and it appeared that at the beginning of his career the furnishing of expert evidence was a relatively simple matter—an effluent was "injurious" because he (the analyst) said so! Now all was changed and in a prosecution at the present day there were elaborate charts, etc., detailed figures and samples —and so, he added, "time marches on." It was impossible now to prove a case merely by saying an effluent was injurious because the analyst said so. Expert evidence was called on both sides and the Bench decided after hearing experts on both sides. In the case of a dispute under the Colne Valley Act arbitration was provided for in certain circumstances.

Mr. C. B. Townend, B.Sc., M.Inst.C.E. (Vice- President), thought that all the members would be very grateful to the Author for his useful and most instructive summary of the legal position on what was a somewhat complicated subject. There had been no lack of legislation to protect rivers and the present defects in the general position had resulted almost entirely from inadequate administration. As an exception, there was no doubt that the Thames Conservancy had proved to be an almost ideal organisation for protecting river interests and it was not surprising that there was a growing body of opinion in favour of having one authority for controlling all river activities within a large catchment area.

As regards pollution, recommendations for setting up River Boards had been made by every Royal Commission and Advisory Committee since 1857, nearly 90 years ago, but the legislation that had followed had always been permissive and not compulsory. That was the reason why so few Boards had been formed. This was undoubtedly one of the main reasons for the failure of the 1876 Act and it was perhaps not too much to hope that in the process of post-war re-organisation, legislation would be accepted for the compulsory enforcement of the law.

The Author had stated that if the law were enforced we could reasonably expect to find "drinking water" conditions in our rivers. He would like to know if that were strictly true. The Public Health Act of 1936 merely repeated the principles of the earlier Acts, that sewage must be treated so that it shall not affect prejudicially the purity or quality of the water in a river. Did that not mean that the sewage effluent needed to be only as good as the quality of the water in the river into which it was discharged? In an industrial area, a river might progressively deteriorate along its course towards the sea by pollution which might not be traceable to any particular cause, and which there-

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fore might be held to be natural pollution. As the law stood, presumably the quality of the sewage effluent discharged into an inferior section of a river could be lower than if discharged into the same river at some point upstream where the quality of the water might be relatively pure. This defect in the law might well be superseded by definite standards for purity of effluents, which might be laid down on some sliding scale to suit the variety of circumstances arising. Otherwise the difficulty in attempting to clean up a badly polluted river might be insuperable.

The Author had mentioned the standard of purity in the Thames Conservancy Area but it would be well to correct a little misapprehension with regard to Clause 63 of the Middlesex County Council Bill now before Parliament and which appeared to be set out in the paper as something new. There was nothing new in that clause. This Bill was merely a Consolidation measure and repeated the wording of the 1931 and 1938 Acts. As a matter of fact, he believed that the West Middlesex case of 1931 was the first of its kind in the country in which a drainage authority had accepted the obligation to comply with a standard of purity laid down in an Act of Parliament.

With regard to prescriptive rights, did not the Author think it was about time that such rights should be abolished. Pollution was either right or wrong and it did not seem to be democratic that people should be allowed to continue pollution for the sole reason that they had been polluting for the past 100 years.

The Author referring to prescriptive rights, said the whole problem of rights of property was a difficult one to discuss on such an occasion and the question of abolishing such rights without compensation might cause a lot of trouble in the political sphere, The matter had been already dealt with by Statute in certain cases.

Colonel Mackenzie said that no sewage effluent, however well clarified, was fit to drink. It was bacterially unfit to drink and when the Author had spoken of pure drinking water from rivers he did not mean this in a literal sense. Clearly, he meant to imply water having the appearance of drinking water and therefore the statement in the paper to which Mr. Townend had objected was a reasonable one.

The Author referring to the question of the prevention of pollution being an administrative question rather than a statutory one, said his statement was in line with the Report of the Joint Advisory Committee on River Pollution and the third report of the Central Advisory Water Committee (see Milne Committee). Numerous committees had dealt with the problem and one committee had stated that it was not so much that the Statutes were defective, but rather the administration of the various Acts of Parliament was defective, and the Committee made certain recommendations. The Milne Report suggested that the new River Boards should use the provisions of the Rivers Pollution Acts, but in his view these Acts did not go far enough. He suggested that a general code of law relating to the prevention of pollution might be based on the best clauses of the Rivers Pollution Acts and the Thames Conservancy Acts. The West Riding River Board had certain powers which were very useful and a whole Code might be prepared which would provide the most effective means of dealing with this problem.

He ought to make it clear, however, that although in the discussion he had spoken a great deal about prosecutions, it was not that which was primarily in mind. Indeed, that was the very last thing he personally had in mind. It was, of course, essential to have some sanction behind the powers possessed by any pollution authority and then it should rarely be necessary for such powers to be used in the Courts. In practice, 95 per cent. of the Thames Conservancy prevention of pollution was done by their Inspectors who saw the people concerned, agreed what was to be done and saw that the remedial measures were carried out. Therefore, when he said this was more a problem of administration than Statute, he meant that the main pollution prevention work was done by the Inspectors on the job. Therefore, he believed that the establishment of Rivers Boards with proper staffs would go far to prevent pollution. At the same time, it might be necessary to alter the law in certain respects to give these Boards the powers that would be required. One of the weaknesses of the Rivers Pollution Acts was that they preserved to some extent the *status quo*.

He regarded the prevention of pollution as so important that the Government, in peace time, should face up to the fact that it was necessary to have pure rivers in the interests of water supply and generally for the benefit of the community. If necessary, industry should be subsidised to enable it to carry out the necessary remedial measures where a particular industry could not afford to pay the whole cost. This should be regarded as in the public interest.

He thanked Colonel Mackenzie for his support in referring to pure drinking water from rivers. It was exactly as Colonel Mackenzie had said and perhaps the slight misunderstanding had been due to trying to deal with a very complicated subject in a few words. It was not suggested that in any particular stream there would be found water fit to drink. Of course, the Metropolitan Water Board took water from the Thames and purified it, if only as a matter of precaution.